Louisiana Refining Division

Marathon Petroleum Company LP
Post Office Box AC
Garyville, LA 70051-0849
Phone 985/535-2241
FAX 985/535-7177

CERTIFIED MAIL - RETURN RECEIPT
REQUEST NO. 7003 2260 0001 4054 1104

May 20, 2014

Vivian Aucoin, Environmental Scientist Manager
Louisiana Department of Environmental Quality
Air Permits Division – Manufacturing Section
P. O. Box 4313
Baton Rouge, LA 70821-4313

Re: *Stack Test Results – Unit 30 FCCU Regenerator Vent (EQT 0165)*
Marathon Petroleum Company LP
Louisiana Refining Division – Garyville, Louisiana
Agency Interest No. 3165

Dear Ms. Aucoin:

Marathon LRD conducted a series of stack tests on the Unit 30 FCCU Regenerator Vent (EQT 0165). The tests were conducted to verify compliance with the particulate matter (PM_{10}), total volatile organic compounds (VOC's), hydrogen cyanide (HCN), and sulfur trioxide (SO3) permit limits found in Permit No. 2580-00013-V12. Two conditions were targeted during testing. Condition 1 targeted a liquid to gas ratio (L/G) of 18 G/MSCF, while Condition 2 was tested at approximately 21 G/MSCF which reflects the current L/G ratio limit in Permit No. 2580-00013-V12. Two valid test runs for PM_{10} were conducted at Condition 1; a third run was deemed invalid due to a process upset.

Condition 2 showed an increase in SO_3 just above the allowable annual lbs/hr average (permitted annual average is 8.50 lbs/hr), however, test results indicate the FCCU Regenerator Vent was able to comply with the maximum allowable lbs/hr limits found in Permit No. 2580-00013-V12. The SO_3 results indicated from Condition 2 are not consistent with previous testing, therefore a follow-up test will be conducted the week of June 23, 2014.

If you have any questions concerning this matter, please contact David Calebaugh of my staff at (985) 535-7142 or via email at DMCalebaugh@marathonpetroleum.com.

Sincerely,

Paula Bremer
Environmental Supervisor
DMC

PB/DMC:jlw
2014-2029-05.docx

ATTACHMENTS

2014 MAY 22 PM 1:24
DEQ - OES

VPP Voluntary Protection Programs
National Partnership for Environmental Priorities
Environmental Leadership Louisiana Department of Environmental Quality P2 Pollution Prevention
Responsible Care® Good Chemistry at Work

BOBBY JINDAL
GOVERNOR

PEGGY M. HATCH
SECRETARY

State of Louisiana

DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL SERVICES

Certified Mail No. 7012 3460 0000 8286 6931

Activity No.: PER20130011
Agency Interest No. 3165

Mr. Aulton J. Anderson
Deputy Assistant Secretary
Marathon Petroleum Company LP
By: MPC Investment LLC, General Partner
PO Box AC
Garyville, LA 70051

RE: Part 70 Operating Permit Modification, Marathon Petroleum Co LP - LA Refining Division - Garyville Refinery, Garyville, St. John the Baptist Parish, Louisiana

Dear Mr. Aulton J. Anderson:

This is to inform you that the permit modification for the above referenced facility has been approved under LAC 33:III.501. The permit is both a state preconstruction and Part 70 Operating Permit. The submittal was approved on the basis of the emissions reported and the approval in no way guarantees the design scheme presented will be capable of controlling the emissions as to the types and quantities stated. A new application must be submitted if the reported emissions are exceeded after operations begin. The synopsis, data sheets and conditions are attached herewith.

It will be considered a violation of the permit if all proposed control measures and/or equipment are not installed and properly operated and maintained as specified in the application.

Operation of this facility is hereby authorized under the terms and conditions of this permit. This authorization shall expire at midnight on the _8th_ of __July__, 2015, unless a timely and complete renewal application has been submitted six months prior to expiration. Terms and conditions of this permit shall remain in effect until such time as the permitting authority takes final action on the application for permit renewal. The permit number and agency interest number cited above should be referenced in future correspondence regarding this facility.

Please be advised that pursuant to provisions of the Environmental Quality Act and the Administrative Procedure Act, the Department may initiate review of a permit during its term. However, before it takes any action to modify, suspend or revoke a permit, the Department shall, in accordance with applicable statutes and regulations, notify the permittee by mail of the facts or operational conduct that warrant the intended action and provide the permittee with the opportunity to demonstrate compliance with all lawful requirements for the retention of the effective permit.

Done this 19 day of February, 2014.

Permit No.: 2580-00013-V12

RECEIVED
FEB 24 2014

Sincerely,

Sam L. Phillips
Assistant Secretary

SGQ
c: EPA Region VI

X. Applicable Louisiana and Federal Air Quality Requirements

ID No.:	Description	LAC 33:III.Chapter																
		5	9	11	13	15	2103	2107	2108	2111	2115	2121	2131	2301	29	51	53	56	59
EQT153	8-74, Platformer Charge Interheater (Nos 1-4) (12-1401)			1	1	1													
EQT154	9-74, Platformer Debutanizer Reboiler (12-1402)			1	1	1					1								
EQT155	10-74, Distillate Hydrotreater Reactor Charge Heater (14-1401)			1	1	1													
EQT156	11-74, Distillate Hydrotreater Low Pressure Stripper Reboiler (14-1402)			1	1	1													
EQT157	12-74, HGO Hydrotreater Reactor Charge Heater (15-1401)			1	1	1													
EQT158	13-74, HGO Hydrotreater Low Pressure Feed Heater (15-1403)			1	1	1													
EQT159	14-74, Thermal Oxidizer No. 1 (20-1406)			1	1	1										2			
EQT160	69-74, South Flare Stack (59-1401)			1		1													
EQT161	70-74, Thermal Oxidizer No. 2 (34-1406)			1	1	1										2			
EQT162	83-74, North Flare Stack (59-1451)			1		1													
EQT163	84-74, FCCU Charge Heater (25-1401)			1	1	1					1								
EQT164	85-74, HF Alkylation Main Frac. Reboiler Heaters (27-1401/1402)			1	1	1													
EQT165	86-74, FCCU Regenerator Vent (30-1401)				1	1										2			

X. Applicable Louisiana and Federal Air Quality Requirements

ID No.:	Description	40 CFR 60 NSPS								40 CFR 61					40 CFR 63 NESHAP					40 CFR			
		A	Db	J	Ja	K/Ka	Kb	3Q	3G	A	FF	M	Y	BB	A	F/Q	G/H	CC	3U	51	64	68	82
EQT156	11-74, Distillate Hydrotreater Low Pressure Stripper Reboiler (14-1402)			1											Subpart DDDDD applies								
EQT157	12-74, HGO Hydrotreater Reactor Charge Heater (15-1401)			1											Subpart DDDDD applies								
EQT158	13-74, HGO Hydrotreater Low Pressure Feed Heater (15-1403)			1											Subpart DDDDD applies								
EQT159	14-74, Thermal Oxidizer No. 1 (20-1406)			1															1	1	2		
EQT160	69-74, South Flare Stack (59-1401)				1													1					
EQT161	70-74, Thermal Oxidizer No. 2 (34-1406)			1															1	1	2		
EQT162	83-74, North Flare Stack (59-1451)				1													1					
EQT163	84-74, FCCU Charge Heater (25-1401)			1	1										Subpart CC and DDDDD applies								
EQT164	85-74, HF Alkylation Main Frac. Reboiler Heaters (27-1401/1402)			1											Subpart DDDDD applies								
EQT165	86-74, FCCU Regenerator Vent (30-1401)				1														1	1	2		
EQT166	89-74, Platformer Interheater No. 5 (12-1403)			1											Subpart DDDDD applies								
EQT167	92-80, Sats. Gas Plant Hot Oil Heater (22-1401)			1											Subpart CC and DDDDD applies								
EQT168	100-85, LSR Hydrotreater Charge Heater (8-1401)			1											Subpart DDDDD applies								

INVENTORIES

AI ID: 3165 - Marathon Petroleum Co LP - LA Refining Division - Garyville Refinery
Activity Number: PER20130011
Permit Number: 2580-00013-V12
Air - Title V Regular Permit Minor Mod

Stack Information:

ID	Description	Velocity (ft/sec)	Flow Rate (cubic ft/min-actual)	Diameter (feet)	Discharge Area (square feet)	Height (feet)	Temperature (oF)
Marathon Refinery							
EQT 0159	14-74 - Thermal Oxidizer No. 1 (20-1406)	41	63000	5.71		200	1200
EQT 0160	69-74 - South Flare Stack (59-1401)	65.6	1910	3		200	2000
EQT 0161	70-74 - Thermal Oxidizer No. 2 (34-1406)	41	63000	5.71		200	1200
EQT 0162	83-74 - North Flare Stack (59-1451)	65.6	1410	3		200	2000
EQT 0163	84-74 - FCC Charge Heater (25-1401)	23	66000	7.81		205	476
EQT 0164	85-74 - HF Alkylation Main Frac. Reboiler Heaters (27-1401/1402)	21.1	80400	9		183.5	320
EQT 0165	86-74 - FCC Regenerator Vent (30-1401)	102.28	308457	8		220	140
EQT 0166	89-74 - Platformer Interheater No. 5 (12-1403)	13	49500	9		199.95	500
EQT 0167	92-80 - Sats. Gas Hot Oil Heater (22-1401)	16.75	33300	6.5		155.96	600
EQT 0168	100-85 - LSR Hydrotreater Charge Heater (08-1401)	35.8	5164	1.75		113	643
EQT 0169	101-85 - LSR Hydrotreater Stripper Reboiler (08-1402)	23.2	5146	2.17		113	408
EQT 0170	102-90 - ROSE Deasphalting Heater (7-1401)	18.1	50715	7.72		150	300
EQT 0171	111-91 - Boiler No. 1 (Unit 42) (42-1601)	20	156672.1	12.9		205	530
EQT 0173	1-00 - Coker Charge Heater (5-1401)	25	91855.16	8.83		200	435
EQT 0174	12-00 - Thermal Oxidizer No. 3 (45-1405)	41	6300	5.71		200	1200
EQT 0179	1-04 - GDU Splitter Reboiler (55-1401)	20	68094	8.5		130	530
EQT 0180	2-04 - GDU/HDS Finishing Reactor Feed Heater (55-1402)	20	28510	5.5		130	650
EQT 0181	3-04 - GDU Stabilizer Reboiler (55-1403)	20	25159	5.25		130	535
EQT 0182	1-05 - NDHT Reactor Charge Heater (56-1401)	20	21264.7	4.75		120	600
EQT 0183	2-05 - NDHT/LP Stripper Reboiler (56-1402)	20	21279	4.25		130	650
EQT 0189	5-08 - Naphtha Hydrotreater Reactor Charge Heater (211-1401)	27	26700.61	4.58		150	685
EQT 0190	6-08 - Naphtha Hydrotreater Stripper Reboiler Heater (211-1402)	29.1	28753.93	4.58		150	600
EQT 0195	9-08 - KHT Reacter Charge Heater (214-1401)	31.2	30845.92	4.58		152	635
EQT 0196	10-08 - KHT Stripper Reboiler Heater (214-1402)	31.6	47909.12	5.67		152	635
EQT 0197	11-08 - HCU Train 1 Reactor Charge Heater (215-1401)	114.5	76599.7	5.33		150	757
EQT 0198	12-08 - HCU Train 2 Reactor Charge Heater (215-1402)	114.5	76599.7	5.33		150	757
EQT 0199	13-08 - HCU Fractionator Heater (215-1403)	26	110667.09	9.5		150	415
EQT 0201	15-08 - Coker Charge Heater (205-1401)	29	118880.34	9.33		225	350
EQT 0202	16-08 - Boiler No. 1 (236-1601)	60.2	137213.67	6.96		90	335
EQT 0204	18-08 - Thermal Oxidizer No. 4 (220-1405)	41	12075.69	2.5		200	600
EQT 0205	19-08 - Thermal Oxidizer No. 5 (234-1405)	41	12075.69	2.5		200	600
EQT 0208	71-2831 - Diesel Powered Emergency Generator (Dock 5)	225.2	176.87	1		10	400

EMISSION RATES FOR CRITERIA POLLUTANTS AND CO2e

AI ID: 3165 - Marathon Petroleum Co LP - LA Refining Division - Garyville Refinery

Activity Number: PER20130011

Permit Number: 2580-00013-V12

Air - Title V Regular Permit Minor Mod

	CO			NOx			PM10			SO2		
Subject Item	**Avg lb/hr**	**Max lb/hr**	**Tons/Year**	**Avg lb/hr**	**Max lb/hr**	**Tons/Year**	**Avg lb/hr**	**Max lb/hr**	**Tons/Year**	**Avg lb/hr**	**Max lb/hr**	**Tons/Year**
Marathon Refinery												
EQT 0149 4-74		25.17			11.00			2.28			10.41	
EQT 0150 5-74		28.56			12.48			2.58			11.82	
EQT 0151 6-74		10.45			16.31			0.95			4.32	
EQT 0152 7-74		10.48			16.08			0.95			4.33	
EQT 0153 8-74		77.21			79.70			6.99			31.95	
EQT 0154 9-74		10.62			16.86			0.96			4.39	
EQT 0155 10-74		0.10			9.12			1.70			7.77	
EQT 0156 11-74		0.02			13.21			1.16			5.30	
EQT 0157 12-74		2.07			68.36			1.93			9.52	
EQT 0158 13-74		1.15			37.97			1.07			5.29	
EQT 0159 14-74		2.75			5.67			0.50			56.86	
EQT 0160 69-74	54.80	785.51	240.04	10.65	152.61	46.64	4.23	60.60	18.52	41.59	1540.91	182.16
EQT 0161 70-74		1.26			7.18			0.50			56.86	
EQT 0162 83-74	70.88	379.98	310.45	13.77	73.82	60.32	5.47	29.31	23.95	24.31	1630.85	106.49
EQT 0163 84-74		0.06			18.36			0.74			27.44	
EQT 0164 85-74		0.04			23.56			2.47			20.07	
EQT 0165 86-74	144.53	481.76	633.03	61.73	96.56	270.40	24.00	77.60	105.12	39.64	110.12	173.63
EQT 0166 89-74		38.08			50.87			3.45			15.76	
EQT 0167 92-80		13.39			17.83			1.21			11.54	
EQT 0168 100-85		3.33			3.57			0.30			1.38	
EQT 0169 101-85		3.33			3.09			0.30			1.38	
EQT 0170 102-90		0.05			27.11			2.17			15.39	
EQT 0171 111-91		2.55			97.80			0.70			26.45	

EMISSION RATES FOR CRITERIA POLLUTANTS AND CO2e

AI ID: 3165 - Marathon Petroleum Co LP - LA Refining Division - Garyville Refinery

Activity Number: PER20130011

Permit Number: 2580-00013-V12

Air - Title V Regular Permit Minor Mod

	VOC			Lead			PM2.5		
Subject Item	**Avg lb/hr**	**Max lb/hr**	**Tons/Year**	**Avg lb/hr**	**Max lb/hr**	**Tons/Year**	**Avg lb/hr**	**Max lb/hr**	**Tons/Year**
Marathon Refinery									
EQT 0149 4-74		1.65						2.28	
EQT 0150 5-74		1.87						2.58	
EQT 0151 6-74		0.68						0.95	
EQT 0152 7-74		0.69						0.95	
EQT 0153 8-74		5.06						6.99	
EQT 0154 9-74		0.70						0.96	
EQT 0155 10-74		0.03						1.70	
EQT 0156 11-74		0.02						1.16	
EQT 0157 12-74		0.17						1.93	
EQT 0158 13-74		0.10						1.07	
EQT 0159 14-74		0.09						0.50	
EQT 0160 69-74	42.13	1325.21	184.51				4.23	60.60	18.52
EQT 0161 70-74		0.09						0.50	
EQT 0162 83-74	65.22	589.73	285.68				5.47	29.31	23.95
EQT 0163 84-74		2.62						0.74	
EQT 0164 85-74		0.10						2.47	
EQT 0165 86-74	6.81	7.09	29.84	0.001	0.002	<0.01	13.71	44.34	60.07
EQT 0166 89-74		2.49						3.45	
EQT 0167 92-80		0.88						1.21	
EQT 0168 100-85		0.22						0.30	
EQT 0169 101-85		0.22						0.30	
EQT 0170 102-90		0.14						2.17	
EQT 0171 111-91		0.93						0.70	

EMISSION RATES FOR TAP/HAP & OTHER POLLUTANTS

AI ID: 3165 - Marathon Petroleum Co LP - LA Refining Division - Garyville Refinery

Activity Number: PER20130011

Permit Number: 2580-00013-V12

Air - Title V Regular Permit Minor Mod

Emission Pt.	Pollutant	Avg lb/hr	Max lb/hr	Tons/Year
EQT 0160 69-74	Polynuclear Aromatic Hydrocarbons	<0.001	0.001	<0.001
	Propylene	0.90	1133.22	3.92
	Toluene	<0.001	0.01	<0.01
	Xylene (mixed isomers)	0.004	0.06	0.02
	n-Hexane	0.28	4.04	1.23
EQT 0161 70-74	Hydrogen sulfide		0.01	
EQT 0162 83-74	1,3-Butadiene	0.26	8.47	1.16
	1,4-Dichlorobenzene	<0.001	0.001	<0.01
	Acetaldehyde	0.002	0.01	0.01
	Acrolein	0.003	0.02	0.02
	Benzene	0.65	5.90	2.86
	Ethyl benzene	0.003	0.02	0.01
	Ethylene	2.85	30.69	12.46
	Formaldehyde	0.02	0.08	0.07
	Hydrogen sulfide	0.24	40.19	1.05
	Naphthalene	<0.001	<0.001	<0.01
	Naphthalene (and Methyl naphthalenes)	<0.001	<0.001	<0.01
	Phenol	<0.001	0.004	<0.01
	Polynuclear Aromatic Hydrocarbons	<0.001	<0.001	<0.001
	Propylene	8.25	411.14	36.15
	Toluene	<0.001	0.004	<0.01
	Xylene (mixed isomers)	0.01	0.03	0.02
	n-Hexane	0.37	1.95	1.60
EQT 0165 86-74	Antimony (and compounds)	0.004	0.01	0.02
	Arsenic (and compounds)	0.03	0.08	0.11
	Barium (and compounds)	<0.001	0.002	0.002
	Benzene	0.03	0.03	0.11
	Cadmium (and compounds)	<0.001	<0.001	<0.001
	Carbon disulfide	0.31	0.44	1.38
	Chromium VI (and compounds)	0.001	0.001	0.002
	Hydrogen cyanide	22.99	28.35	100.72
	Mercury (and compounds)	<0.001	<0.001	<0.001
	Methanol	0.06	0.13	0.28
	Nickel (and compounds)	0.001	0.003	<0.01

EMISSION RATES FOR TAP/HAP & OTHER POLLUTANTS

AI ID: 3165 - Marathon Petroleum Co LP - LA Refining Division - Garyville Refinery

Activity Number: PER20130011

Permit Number: 2580-00013-V12

Air - Title V Regular Permit Minor Mod

Emission Pt.	Pollutant	Avg lb/hr	Max lb/hr	Tons/Year
EQT 0165 86-74	Sulfuric acid	8.50	12.75	37.22
	Toluene	0.07	0.07	0.29
	Xylene (mixed isomers)	0.07	0.07	0.29
	n-Hexane	0.07	0.07	0.29
EQT 0167 92-80	Formaldehyde		0.003	
	Propylene		0.01	
EQT 0174 12-00	Hydrogen sulfide		0.01	
EQT 0178 3-05	2,2,4-Trimethylpentane		0.08	
	Benzene		0.01	
	Cumene		<0.001	
	Ethyl benzene		0.004	
	Naphthalene		0.001	
	Toluene		0.03	
	Xylene (mixed isomers)		0.02	
	n-Hexane		0.01	
EQT 0201 15-08	Ammonia		5.07	
EQT 0204 18-08	Hydrogen sulfide		0.01	
EQT 0205 19-08	Hydrogen sulfide		0.01	
EQT 0210 23-08	Chlorinated Dibenzo-P-Dioxins	<0.001	<0.001	<0.001
	Chlorinated dibenzofurans	<0.001	<0.001	<0.001
	Hydrochloric acid	0.51	0.64	2.25
EQT 0211 24-08	1,3-Butadiene	0.002		0.01
	Benzene	0.003		0.01
	Cumene	0.001		<0.01
	Ethyl benzene	0.01		0.04
	Ethylene	0.003		0.01
	Propylene	0.04		0.19
	Toluene	0.02		0.09
	Xylene (mixed isomers)	0.03		0.13
	Zinc (and compounds)	0.004		0.02
	n-Hexane	0.002		0.01
EQT 0212 31-08	Nickel (and compounds)	<0.001	<0.001	<0.001
EQT 0213 32-08	2,2,4-Trimethylpentane	<0.001		<0.01
	Benzene	0.004		0.02

EQT 0165 86-74 - FCC Regenerator Vent (30-1401)

1433	[40 CFR 60.105a(g)]	Sulfur dioxide monitored by continuous emission monitor (CEM) continuously. Maintain SO2 concentration limit of 50 ppmvd determined on a seven day rolling average basis and a concentration limit of 25 ppmvd on a 365 day rolling average. Subpart Ja. [40 CFR 60.105a(g), 40 CFR 51.166, LAC 33:III.509] Which Months: All Year Statistical Basis: None specified
1434	[40 CFR 60.106a]	Determine compliance with standards using the test methods and procedures specified in 40 CFR 60.104a (a) through (j) as applicable. Subpart Ja. [40 CFR 60.106a, 40 CFR 51.166, LAC 33:III.509]
1435	[40 CFR 60.108a]	Equipment/operational data recordkeeping by electronic or hard copy continuously. Keep records of the information specified in 40 CFR 60.108a (a) through (d), as applicable. Subpart Ja.
1436	[40 CFR 60.108a]	Rc & operating hours recordkeeping by electronic or hard copy daily. Record the average coke burn-off rate (tons per hour) and hours of operation. Where Rc is carbon burn rate. Subpart Ja.
1437	[40 CFR 60.108a]	Submit exceedance report: Due semiannually, except as specified in 40 CFR 60.108a(d). Subpart Ja.
1438	[40 CFR 60.13(d)(1)]	Recordkeeping: Equipment/operational recordkeeping by continuous emission monitor (CEM) daily in accordance with the quality assurance and quality control (QA/QC) procedures as per NSPS, 40 CFR 60, Appendix F. Record and quantify the CEM excess zero span drift whenever specified. [Subpart A, Consent Decree]. [40 CFR 60.13(d)(1), 40 CFR 60.Appendix F]
1439	[40 CFR 63.1565]	The permitte shall continuously monitor and record the following for the Flue Gas Scrubber: (a) Scrubber liquid feed rate (L); (b) Flue gas flow rate to the Scrubber (G); (c) Determine the Liquid to Gas ratio (L/G). Shall conduct a check of the water pressure to the spray nozzles and record the results of each check. Excess emissions shall be reported to the Office of Environmental Compliance. The excess emissions are defined as follows: (a) Any 3-hour rolling average L/G ratio is less than 20.71 (established during the stack tests conducted in December 2011 and April 2012); and (b) Water pressure to the spray nozzles is not checked and recorded daily. Daily records shall be kept on site and available for inspection by the Office of Environmental Compliance. Total suspended particulate <= 1.0 kg/Mg (2.0 lb/ton) of coke burn-off. Subpart Ja. [40 CFR 63.1565, 40 CFR 63.1564, 40 CFR 60.102a(c)(2), LAC 33:III.509, 40 CFR 51.166, 40 CFR 60.105a(b)(1)(ii)] Which Months: All Year Statistical Basis: None specified
1440	[LAC 33:III.1313.C]	Total suspended particulate <= 0.6 lb/MMBTU of heat input. Which Months: All Year Statistical Basis: None specified
1441	[LAC 33:III.1513]	Equipment/operational data recordkeeping by electronic or hard copy continuously. Record and keep on site for at least two years the data required to demonstrate exemption from the provisions of LAC 33:III.Chapter 15. Record all emissions data in the units of the standard using the averaging time of the standard. Make records available to a representative of DEQ or the U.S. EPA on request.
1442	[LAC 33:III.507.H.1.a]	Permittee shall limit NOx emissions to 96.56 lb/hr on a seven day rolling average and limit NOx emissions to 270.40 tons/yr on a 365 day rolling average. Permittee shall conduct performance evaluations of each NOx monitor according to the requirements in 40 CFR 60.13(c) and Performance Specification 2 of 40 CFR 60.Appendix B and the quality assurance and quality control (QA/QC) measures as per NSPS, 40 CFR 60, Appendix F. These records shall be kept on site and available for inspection by the Office of Compliance, Surveillance Division. Nitrogen oxides monitored by continuous emission monitor (CEM) continuously. Subpart Ja. [LAC 33:III.507.H.1.a, 40 CFR 51.166, LAC 33:III.509] Which Months: All Year Statistical Basis: None specified
1443	[LAC 33:III.507.H.1.a]	Sulfur Trioxide: Permittee shall compute the sulfur trioxide and VOC emissions by multiplying the flue gas flow rate by the emission factor obtained through stack tests. [LAC 33:III.507.H.1.a, LAC 33:III.509, 40 CFR 51.166]
1444	[LAC 33:III.507]	The permittee shall comply with the short term limits for FCCU NOx emissions limit based on the Hydrotreater outage NOx Minimization Plan that has been submitted to the EPA at all times during the period of startup, shutdown, and malfunction of the Hydrotreater. [Consent Decree].

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1424	[40 CFR 51.166]	Particulate matter (10 microns or less): Particulate matter (PM) shall be calculated by mutiplying the coke burn-off rate by the average PM emission factor from the last three stack tests of the FCCU Regenerator. The permittee shall perform annual stack test to ensure the emission factor remains representative of actual operations. Coke burn-off rate record shall be kept on site and available for inspection by the Office of Environmental Compliance, Surveillance Division. [40 CFR 51.166, LAC 33:III.509, LAC 33:III.507.H.1.a]
1425	[40 CFR 60.100a]	As per NSPS, 40 CFR 60, Appendix F, Sections 5.1.1, 5.1.3, and 5.1.4 the permittee shall conduct either a Relative Accuracy Audit (RAA) or Relative Accuracy Test Audit (RATA) once every four calendar quarters, provided that a Cylinder Gas Audit (CGA) is conducted each calendar quarter. These records shall be kept on site and available for inspection by Department of Environmental Quality personnel. Nitrogen oxides emissions monitored by continuous emission monitor (CEM). [Consent Decree]. [40 CFR 60.100a, 40 CFR 60.Appendix F]
1426	[40 CFR 60.102a(b)(3)]	Sulfur dioxide (SO2) <= 50 ppmdv; or Sulfur dioxide <= 25 ppmvd on a 365-day rolling average. Subpart Ja. [40 CFR 60.102a(b)(3), LAC 33:III.1503, LAC 33:III.509, 40 CFR 51.166] Which Months: All Year Statistical Basis: Seven-day rolling average
1427	[40 CFR 60.102a(b)(4)]	Carbon monoxide (CO) <= 500 ppmv (dry basis) corrected to zero percent excess air. Subpart Ja. [40 CFR 60.102a(b)(4)] Which Months: All Year Statistical Basis: Hourly average
1428	[40 CFR 60.103a(b)]	Permittee shall limit CO emissions to 481.76 lb/hr on a one-hour average and limit CO emissions to 633.03 tons/yr on a 365 day rolling average. Permittee shall conduct performance evaluations of each O2 and CO monitor according to the requirements in 40 CFR 60.13(c) and Performance Speciation 4 or 4A of 40 CFR 60.Appendix B. Shall maintain the CEM in accordance with the quality assurance and quality control (QA/QC) measures as per NSPS, 40 CFR 60, Appendix F. These records shall be kept on site and available for inspection by the Office of Compliance, Surveillance Division. Carbon monoxide (CO) monitored by continuous emission monitor (CEM) continuously, except as provided in 40 CFR 60.105a(h). Subpart Ja. [40 CFR 60.103a(b), 40 CFR 60.105a(b)(2), 40 CFR 51.166, LAC 33:III.509] Which Months: All Year Statistical Basis: None specified
1429	[40 CFR 60.104a(a-j)]	Use as reference methods and procedures the test methods in 40 CFR 60 appendix A or other methods and procedures as specified in 40 CFR 60.104a, except as provided in 40 CFR 60.8(b), in conducting the performance tests required in 40 CFR 60.8. Subpart Ja. [40 CFR 60.104a(a-j)]
1430	[40 CFR 60.105a(a)(g)]	Permittee shall limit SO2 emissions to 110.12 lb/hr on a seven day rolling average and limit SO2 emissions to 173.63 tons/yr on a 365 day rolling average. Permittee shall conduct performance evaluations of each SO2 monitor according to the requirements in 40 CFR 60.13(c) and Performance Specification 2 of 40 CFR 60.Appendix B and the quality assurance and quality control (QA/QC) measures as per NSPS, 40 CFR 60, Appendix F. These records shall be kept on site and available for inspection by the Office of Compliance, Surveillance Division Sulfur dioxide monitored by continuous emission monitor (CEM) continuously at the outlet of the SO2 control device. Subpart Ja. [40 CFR 60.105a(a)(g), 40 CFR 51.166, LAC 33:III.509] Which Months: All Year Statistical Basis: None specified
1431	[40 CFR 60.105a(b)(2)]	Oxygen monitored by continuous emission monitor (CEM) continuously at both the inlet and outlet of the sulfur dioxide control device (or the outlet only if specifically complying with the 50 ppmv standard). Subpart Ja. [40 CFR 60.105a(b)(2)] Which Months: All Year Statistical Basis: None specified
1432	[40 CFR 60.105a(d, f, g, h)(12)	Use the procedures in 40 CFR 60.105a to evaluate the continuous monitoring systems. Subpart Ja. [40 CFR 60.105a(d, f, g, h)(12)]

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1445 [LAC 33:III.509.H.1] Particulate Matter <= 1 lb/1000 lb of coke burn on a three hour rolling average. [Consent Decree].

1446 [LAC 33:III.509] Full burn operation is considered as BACT for control of CO, and VOC emissions. [LAC 33:III.509, 40 CFR 51.166]

1447 [LAC 33:III.509] Nitrogen dioxide <= 61 ppmv at 0% oxygen based on seven day rolling average and 41 ppmv at 0% oxygen based on 365 day rolling average by utilizing Catalyst Additives. [Consent Decree].
Which Months: All Year Statistical Basis: Annual average

1448 [LAC 33:III.509] Particulate matter (10 microns or less) <= 0.60 lb/ton of coke burn rate is considered as BACT. [LAC 33:III.509, 40 CFR 51.166]
Which Months: All Year Statistical Basis: Annual average

1449 [LAC 33:III.509] Permittee shall comply with all the applicable requirements of 40 CFR 63, Subpart UUU. [LAC 33:III.509, 40 CFR 51.166, 40 CFR 63.1564]

1450 [LAC 33:III.509] Permittee shall use the equations cited below to determine the flue gas flow rate from the FCCU Regenrator before entering the emissions control system:
Equation A :- Flue Gas Rate = DryAir(lbmol/hr) * (100 - OxyEnr/Inerts)

Equation B :- DryAir(lbmol/hr) = WetAir(lbmol/hr) * (1 - (MolesH2O/MolesWetAir))
Where WetAir(lbmol/hr) = (MABFlow(scfm) * 60(min/hr)) + PipelineO2Flow(scfh)/379(scf/lbmol)
Where MABFlow(scfm) = Main Air Blower flow rate as read by the flow meter located on the air blower pipeline in standard cubic feet per hour (scfh)
Where PipelineO2Flow = Pipeline O2 flow rate as read by the flow meter located at the O2 pipeline in standard cubic feet per hour (scfh)

MolesH2O/MolesWetAir in Equation B shall be calculated using the following equations:
PH2O/Ptotal = MolesH2O/MolesWetAir = (MolesH2O/(MolesH2O + MolesDryAir) = (PvRH/(100 * 14.7)
Where Pv = 10 to the power of (6.40375 - 3165.36/T + 392.565), and T is ambient temperature in Fahrenheit

Inerts in the Equation A shall be calculated as follows:
Inerts = 100 - (CO(ppm)/10000) - CO2(mole%) - O2(mole%))
Where CO, CO2 and O2 data is obtained from CEMs. [LAC 33:III.509, 40 CFR 51.166, LAC 33:III.507.H.1.a]

EQT 0166 89-74 - Platformer Interheater No. 5 (12-1403)

1451 [40 CFR 60.104(a)(1)] Fuel gas: Hydrogen sulfide <= 0.1 gr/dscf (230 mg/dscm) or less than 162 ppm on a three hour rolling average. Subpart J. [40 CFR 60.104(a)(1)]
Which Months: All Year Statistical Basis: Three-hour rolling average

1452 [40 CFR 60.104(a)(1)] The waste gas streams meet the exemption criteria in 40 CFR 60.14(e)(5) and was approved by LDEQ by letter dated January 28, 1999. The permittee shall monitor the H2S from the stream before combustion as per the requirements of the Alternative Monitoring Plan submitted to EPA. [40 CFR 60.104(a)(1)]

1453 [40 CFR 60.105(a)(4)] Hydrogen sulfide monitored by continuous emission monitor (CEM) continuously. The span of the analyzer is 300 ppm. Monitor the H2S in fuel gases before being burned in any fuel gas combustion device. Subpart J. [40 CFR 60.105(a)(4)]
Which Months: All Year Statistical Basis: None specified

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REPORT ON COMPLIANCE TESTING

Performed for:
MARATHON PETROLEUM COMPANY LP
FCC REGENERATOR VENT (EQT 0165)
GARYVILLE, LA

Client Reference No: Verbal
CleanAir Project No: 12461
Revision 0: May 15, 2014

To the best of our knowledge, the data presented in this report are accurate, complete, error free, legible and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies.

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REVISION HISTORY

REPORT ON COMPLIANCE TESTING

DRAFT REPORT REVISION HISTORY

Revision:	Date	Pages	Comments
D0a	05/07/14	All	Draft version of original document.

FINAL REPORT REVISION HISTORY

Revision:	Date	Pages	Comments
0	05/15/14	All	Final version of original document.

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PROJECT OVERVIEW

INTRODUCTION

Marathon Petroleum Company LP (MPC) contracted Clean Air Engineering (CleanAir) to perform emission measurements at the Garyville Refinery, located in Garyville, Louisiana, for compliance purposes.

All testing was conducted in accordance with the regulations set-forth by the United States Environmental Protection Agency (EPA) and the Louisiana Department of Environmental Quality (DEQ). The permit limits are referenced in the State of Louisiana Department of Environmental Quality, Environmental Services, Permit No. 2580-00013-V11.

Key Project Participants

Individuals responsible for coordinating and conducting the test program were:

D. Calebaugh – MPC
K. Braxton – DEQ
S. Lehmann – CleanAir

PROJECT OVERVIEW

Test Program Parameters

The testing was performed at the FCC Regenerator Vent and included the following emissions measurements:

- particulate matter (PM), assumed equivalent to filterable particulate matter (FPM) only
- total particulate matter less than 10 microns (µm) in diameter (Total PM_{10}), assumed equivalent to the sum of the following constituent:
    - filterable particulate matter (FPM)
    - condensable particulate matter (CPM)
- sulfuric acid mist (H_2SO_4)
- hydrogen cyanide (HCN)
- volatile organic compounds (VOCs), assumed equivalent to total hydrocarbons (THC) *minus* the following constituents:
    - methane (CH_4)
    - ethane (C_2H_6)
- flue gas flow rate
- flue gas velocity decay (wall effects)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas temperature

Testing was performed under two separate scrubber conditions. Condition 1 utilized a Liquid to Gas (L/G) ratio of approximately 18 and the Condition 2 L/G was approximately 21.

TEST PROGRAM SYNOPSIS

Test Schedule

The on-site schedule followed during the test program is outlined in Table 1-1 on the following page.

PROJECT OVERVIEW

Table 1-1:
Schedule of Activities

Run Number	Location	Method	Analyte	Date	Start Time	End Time
Condition 1						
1	FCCU Regenerator Vent	Method 2F, 2H	3D Flow, Wall Effects	03/18/14	10:10	10:34
1	FCCU Regenerator Vent	USEPA Method 5/202	Particulate/CPM	03/18/14	10:45	12:01
1	FCCU Regenerator Vent	USEPA OTM 029	Hydrogen Cyanide	03/18/14	10:45	12:01
2	FCCU Regenerator Vent	Method 2F	3D Flow	03/18/14	12:14	12:46
2	FCCU Regenerator Vent	USEPA Method 5/202	Particulate/CPM	03/18/14	17:56	19:09
2	FCCU Regenerator Vent	USEPA OTM 029	Hydrogen Cyanide	03/18/14	17:56	19:09
3	FCCU Regenerator Vent	Method 2F	3D Flow	03/18/14	19:08	19:29
Condition 2						
4	FCCU Regenerator Vent	Method 2F, 2H	3D Flow, Wall Effects	03/19/14	08:11	08:51
3	FCCU Regenerator Vent	USEPA Method 5/202	Particulate/CPM	03/19/14	09:14	10:23
3	FCCU Regenerator Vent	USEPA OTM 029	Hydrogen Cyanide	03/19/14	09:14	10:23
5	FCCU Regenerator Vent	Method 2F	3D Flow	03/19/14	10:09	10:43
4	FCCU Regenerator Stack	USEPA Method 5/202	Particulate/CPM	03/19/14	11:23	12:32
4	FCCU Regenerator Vent	USEPA OTM 029	Hydrogen Cyanide	03/19/14	11:23	12:32
6	FCCU Regenerator Vent	Method 2F	3D Flow	03/19/14	12:20	13:00
5	FCCU Regenerator Stack	USEPA Method 5/202	Particulate/CPM	03/19/14	13:27	14:38
5	FCCU Regenerator Vent	USEPA OTM 029	Hydrogen Cyanide	03/19/14	13:27	14:38
7	FCCU Regenerator Vent	Method 2F	3D Flow	03/19/14	14:24	14:56
6	FCCU Regenerator Stack	USEPA Method 5/202	Particulate/CPM	03/19/14	15:31	16:41
6	FCCU Regenerator Vent	USEPA OTM 029	Hydrogen Cyanide	03/19/14	15:31	16:41
8	FCCU Regenerator Vent	Method 2F	3D Flow	03/19/14	16:31	17:01
Condition 2						
9	FCCU Regenerator Vent	Method 2F, 2H	3D Flow, Wall Effects	03/20/14	09:04	09:23
1	FCCU Regenerator Vent	Method 3A, 25A	O_2, THC	03/20/14	09:07	10:17
1	FCCU Regenerator Vent	USEPA Method 8	H_2SO_4	03/20/14	09:31	10:50
7	FCCU Regenerator Vent	USEPA OTM 029	Hydrogen Cyanide	03/20/14	09:31	11:11
10	FCCU Regenerator Vent	Method 2F	3D Flow	03/20/14	11:40	11:48
2	FCCU Regenerator Vent	USEPA Method 8	H_2SO_4	03/20/14	11:55	13:02
11	FCCU Regenerator Vent	Method 2F	3D Flow	03/20/14	13:00	13:16
2	FCCU Regenerator Vent	Method 3A, 25A	O_2, THC	03/20/14	13:07	14:09
3	FCCU Regenerator Vent	USEPA Method 8	H_2SO_4	03/20/14	13:26	14:32
12	FCCU Regenerator Vent	Method 2F	3D Flow	03/20/14	14:20	14:37
3	FCCU Regenerator Vent	Method 3A, 25A	O_2, THC	03/20/14	14:20	15:22
Condition 1						
13	FCCU Regenerator Vent	Method 2F, 2H	3D Flow, Wall Effects	03/21/14	07:53	08:16
4	FCCU Regenerator Vent	USEPA Method 8	H_2SO_4	03/21/14	08:23	09:32
8	FCCU Regenerator Vent	USEPA OTM 029	Hydrogen Cyanide	03/21/14	08:23	09:32
4	FCCU Regenerator Vent	Method 3A, 25A	O_2, THC	03/21/14	08:34	09:54
14	FCCU Regenerator Vent	Method 2F	3D Flow	03/21/14	09:08	09:55
5	FCCU Regenerator Vent	USEPA Method 8	H_2SO_4	03/21/14	10:06	11:11
5	FCCU Regenerator Vent	Method 3A, 25A	O_2, THC	03/21/14	10:30	11:40
15	FCCU Regenerator Vent	Method 2F	3D Flow	03/21/14	11:01	11:24
6	FCCU Regenerator Vent	USEPA Method 8	H_2SO_4	03/21/14	11:42	12:48
6	FCCU Regenerator Vent	Method 3A, 25A	O_2, THC	03/21/14	12:51	13:52
16	FCCU Regenerator Vent	Method 2F	3D Flow	03/21/14	13:34	13:00
7	FCCU Regenerator Vent	Method 3A, 25A	O_2, THC	03/21/14	14:08	15:11
17	FCCU Regenerator Vent	Method 2F	3D Flow	03/21/14	14:11	14:27

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Results Summary

Table 1-2 summarizes the results of the test program. A more detailed presentation of the test conditions and results of analysis are shown on pages 2-1 through 2-6.

Table 1-2:
Summary of Test Results

Constituent	Sampling Method	Condition 1 Average Emission	Condition 2 Average Emission	Permit Limit[1]
PM_{10}[2] (lb/hr)	USEPA M-5/202	14.35	16.69	24.00
PM_{10}[2] (ton/yr)	USEPA M-5/202	62.84	73.08	105.12
PM_{10}[2] (lb/Mlb coke)	USEPA M-5/202	0.21	0.24	0.30
$PM_{2.5}$[3] (lb/hr)	USEPA M-5/202	14.35	16.69	13.71
$PM_{2.5}$[3] (ton/yr)	USEPA M-5/202	62.84	73.08	60.07
H_2SO_4 (lb/hr)	USEPA M-8	5.60	9.44	8.50
H_2SO_4 (ton/yr)	USEPA M-8	24.51	41.35	37.22
VOC (lb/hr)	USEPA M-25A/18	2.27	3.61	6.81
VOC (ton/yr)	USEPA M-25A/18	9.96	15.82	29.84
HCN (lb/hr)	USEPA OTM-29	21.72	17.59	22.99
HCN (ton/yr)	USEPA OTM-29	95.15	77.03	100.72

[1]Limits obtained from permit No. 2580-00013.V11

05\4\14 14:44:16

[2]PM_{10} = Particulate matter less than 10 microns

[3]$PM_{2.5}$ = Particulate matter less than 2.5 microns

PROJECT OVERVIEW

Discussion of Test Program

PM_{10}, and $PM_{2.5}$ Testing - USEPA Method 5/202

PM_{10} and $PM_{2.5}$ emissions were determined using USEPA Method 5/202. PM_{10} and $PM_{2.5}$ are equivalent to the sum of filterable particulate matter less than 10 micrometers (µm) in diameter (FPM_{10}) and condensable particulate matter (CPM). The M-5/202 sample train yields a front-half, FPM result and a back-half, CPM result. The total PM result (FPM plus CPM) from M-5/202 can be used as a worst-case estimation of Total PM_{10} and Total $PM_{2.5}$ since M-5 will collect all filterable particulate matter present in the flue gas (regardless of particle size).

The front-half (Method 5 portion) of the sampling train consists of a glass nozzle, glass probe liner heated to 250°F and a quartz filter heated to 250°F. Samples were collected isokinetically; nozzle and probe liner recoveries were performed using acetone as the recovery solvent. The sampling train deviated from the protocol in that a filter box allowing direct connection to the impinger train was used in lieu of a cateco heater box and Teflon jumper. Due to this, there was no required Teflon rinse of a jumper during recovery.

The back-half (M-202 portion) of the sampling train is designed to mimic ambient conditions and collect only the particles that would truly form CPM in the atmosphere. This is done by minimizing the sulfur dioxide (SO_2) and nitrogen oxide (NO_X) interferences observed with earlier versions of the method, in which flue gas was bubbled through cold water and SO_2 and NO_X were absorbed and partially oxidized before they could be purged out with nitrogen (N_2).

Flue gas exiting the front-half heated filter passes through a coiled condenser and dry impinger system jacketed by water continually circulated at ambient temperature. Moisture is removed from the flue gas without bubbling through the condensed water. Flue gas then passes through a tetrafluoroethane (TFE) membrane filter at ambient temperature. The temperature of the flue gas at the exit of the filter is directly measured with an in-line thermocouple and maintained in the temperature range of 65° to 85°F.

After exiting the ambient filter, the flue gas passes through two (2) additional impingers surrounded by ice in a "cold" section of the impinger bucket. The moisture collected in these impingers is not analyzed for CPM and is only collected to determine the flue gas moisture and thoroughly dry the gas. The sample gas then flows into a calibrated dry gas meter where the collected sample gas volume is determined.

The sampling system traverses all of the Method 1 points during each run. A minimum volume of 0.9 dry standard cubic meters (dscm), or 31.8 dry standard cubic feet (dscf), were sampled during each 60-minute run.

During analysis, it was noted that the front half filter of Run 2 of M5/202 contained a piece of glass. This filter was weighed prior to removal of the glass and again after removal. The weight used for the purposes of this report is the weight without the glass, as it was determined to be a portion of the sampling train. It should be noted that this run had very high condensable particulate, nearly 50 times the other two runs for Condition 1. This run took place immediately following a period when the unit was either not operating or operating at very low load due to process constraints. CleanAir feels this run is not representative of the stack gas during normal operating conditions and has eliminated it from the averages and final results in this report.

H_2SO_4 Testing – USEPA Method 8

H_2SO_4 emissions were determined using USEPA Method 8.

The front-half of the sampling train consists of a glass nozzle, glass probe liner heated to 250°F, an impinger containing 100ml of 80% isopropyl alcohol (IPA), and an ambient quartz filter. Samples were collected isokinetically; nozzle, probe liner, and the first impinger recoveries were performed using 80% IPA as the recovery solvent.

The sample gas then continues through a series of three additional impingers; two (2) containing water, and one (1) containing silica gel for residual moisture removal. The exit temperature from the knock-out jar set is maintained below 68°F. The sample gas then flows into a calibrated dry gas meter where the collected sample gas volume was determined. Sample trains were purged with ambient air prior to recovery.

Samples and blanks were returned to CleanAir Analytical Services for titration.

O_2, CO_2, and VOC Testing - USEPA Methods 3A, 18, and 25A

O_2 and CO_2 emissions were determined using a paramagnetic/NDIR CEMs analyzer per USEPA Method 3A. VOC emissions were determined using USEPA Method 25A to quantify total hydrocarbon emissions (THC) and USEPA Method 18 to quantify methane (CH_4) and ethane (C_2H_6) emissions. VOC emissions are equivalent to THC emissions, minus CH_4 and C_2H_6 emissions.

PROJECT OVERVIEW

The M-3A/18/25A sampling system consists of a heated probe, heated filter and heated sample line. Flue gas is extracted at a constant rate and delivered at 250°F to a tee at the end of the heated sample line.

- One leg of the tee is connected to a flame ionization analyzer (FIA) which continuously measures minute-average THC concentration expressed in terms of propane (C_3H_8) on an actual (wet) basis.
- The other leg of the tee is connected to a gas conditioner which removes moisture before delivering the gas to a flow panel and the O_2/CO_2 analyzers, which measures concentration on a dry basis (units of %dv or ppmdv).
- The M-18 gas sample is collected by pulling a slipstream from the flow panel and delivering it into a Tedlar bag at a constant rate. The moisture condensate is not collected for analysis as CH_4 and C_2H_6 are insoluble in water. Each bag is filled over a period of one (1) hour for each test run.

THC analyzer calibrations are performed by introducing zero air, high, mid- and low-range C_3H_8 calibration gases to the inlet of the sampling system's heated filter. Bias checks are performed before and after each sampling run in a similar manner.

O_2 / CO_2 calibration error checks are performed by introducing zero nitrogen (N_2), high-range and mid-range calibration gases to the inlet of each analyzer during calibration error checks. Bias checks are performed before and after each sampling run by introducing calibration gas to the inlet of the sampling system's heated filter. Per M-3A, the average results for each run are be drift-corrected. Since moisture is removed from the sample prior to collection and GC analysis, the concentration results are on a dry basis.

Based on the results of the THC analyzer, the M18 Tedlar bags have been archived.

Run 5 is not utilized as the THC analyzer failed the post test drift check. The analyzer was re-calibrated and an additional run was performed. The results from Run 5 are not included in the averages or final results.

HCN Testing – USEPA OTM-29

HCN emissions were determined using OTM-29 and an isokinetic, multi-point sample train. The sampling system consists of a nozzle, heated probe, heated quartz filter, impinger train (for HCN collection and H_2O removal/measurement) and a dry gas meter. The HCN-collecting impingers are charged with 6.0 N sodium hydroxide (NaOH) solution.

The sampling system traverses all of the Method 1 points during each run. A maximum volume of 0.9 dry standard cubic meters (dscm), or 31.8 dry standard cubic feet (dscf), was sampled during each one-hour run.

The sample train is recovered per OTM-29 requirements. The front-half portion of the sample train (nozzle, probe and heated filter) is not recovered or analyzed. The back-half of the heated filter outlet was also not recovered or analyzed. Prior to recovery, the pH of each impinger preceding the final impinger was measured and adjusted to > 12.0 if necessary.

Run 1 had a final impinger with a pH <12.0 and that run was not included in the averages or the final results. It was determined after Run 1 that the planned sampling train would not be adequate for this source. All subsequent runs had an additional impinger containing 200ml of 6.0N NaOH and were operated to collect a lower overall sample volume. Subsequent runs all had pH levels that met the QA requirements of the method. Due to the increased volume collected during the sampling several runs had a third sample collection jar (impingers 1 and 2, impingers 3 and 4, and impinger 5).

Run 4 of this method did not pass a leak check upon completion of the sampling. This run was not included in the averages or final results. Run 2 had isokinetics of 110.4%. The emission rates determined by this run were in line with Runs 3 and 8, both Condition 1, and it was therefore utilized in the calculation of averages and results.

A field train blank was assembled, transported to the location, heated, leak-checked and recovered as if it were an actual test sample. This was used to determine the allowable blank subtraction. A field spike sample was collected by introducing a spike standard into a single impinger containing absorbing reagent and recovering the impinger following standard procedures. The field spike passed all analytical QA/QC requirements. Reagent blanks were collected to quantify background contamination. All samples were stored under refrigeration or cold packs prior to analysis. Samples and blanks were shipped to a lab off- site and analyzed by ion chromatography (IC).

3D Flow Testing and Wall Effects – USEPA M2F and M2H

3D flow traverses were conducted before and after each sampling run for all other constituents. The average of the two 2F runs bracketing each run were utilized in determining the emission rates of these other constituents. The only exception to this is Run 3 of M25A which had a single concurrent 2F run. Additionally, wall effects runs were conducted during the first velocity traverse each day. The calculated factors for these four runs were averaged and applied to each of the 2F runs.

End of Section 1 – Project Overview

RESULTS

Table 2-1:
FCCU Regenerator Vent – $PM_{10}/PM_{2.5}$, Condition 1

Run No.		1	2*	3	Average
Date (2014)		Mar 18	Mar 18	Mar 19	
Start Time (approx.)		10:45	17:56	09:14	
Stop Time (approx.)		12:01	19:09	10:23	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	69.7	70.7	70.1	**69.9**
P_1	L/G	18.1	18.0	18.7	**18.4**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	2.3	2.3	2.3	**2.3**
CO_2	Carbon dioxide (dry volume %)	17.5	17.4	17.5	**17.5**
T_s	Sample temperature (°F)	144	144	144	**144**
B_w	Actual water vapor in gas (% by volume)	22.0	22.1	21.6	**21.8**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	268,000	264,000	272,000	**270,000**
Q_s	Volumetric flow rate, standard (scfm)	232,000	229,000	237,000	**235,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	181,000	178,000	185,000	**183,000**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	36.81	38.05	38.49	**37.65**
%I	Isokinetic sampling (%)	98.9	104.0	103.6	**101.2**
Laboratory Data					
m_n	Total FPM (g)	0.00888	0.02042	0.02006	
m_{CPM}	Total CPM (g)	0.00864	0.04941	0.00717	
m_{Part}	Total particulate (as pm10 & pm2.5) (g)	0.01752	0.06983	0.02723	
FPM Results					
$E_{lb/hr}$	Particulate Rate (lb/hr)	5.78	12.67	12.75	**9.26**
$E_{T/y}$	Particulate Rate (Ton/yr)	25.30	55.49	55.83	**40.56**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.08	0.18	0.18	**0.13**
CPM Results					
$E_{lb/hr}$	Particulate Rate (lb/hr)	5.62	30.66	4.56	**5.09**
$E_{T/y}$	Particulate Rate (Ton/yr)	24.60	134.28	19.96	**22.28**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.08	0.43	0.07	**0.07**
Total Particulate (as PM10 & PM2.5) Results					
$E_{lb/hr}$	Particulate Rate (lb/hr)	11.39	43.33	17.30	**14.35**
$E_{T/y}$	Particulate Rate (Ton/yr)	49.90	189.78	75.79	**62.84**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.16	0.61	0.25	**0.21**

Average includes 2 runs. * indicates that the run is not included in the average.

[1]Gas Flow Rate calculated using M2F and 2H test runs.

RESULTS

Table 2-2:
FCCU Regenerator Vent – H_2SO_4 , Condition 1

Run No.		4	5	6	Average
Date (2014)		Mar 21	Mar 21	Mar 21	
Start Time (approx.)		08:23	10:06	11:42	
Stop Time (approx.)		09:32	11:11	12:48	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	69.9	70.4	70.4	**70.2**
P_1	L/G	18.0	18.0	18.0	**18.0**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	2.0	2.1	1.6	**1.9**
CO_2	Carbon dioxide (dry volume %)	17.5	17.7	18.0	**17.7**
T_s	Sample temperature (°F)	144	144	144	**144**
B_w	Actual water vapor in gas (% by volume)	20.85	21.87	18.82	**20.51**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	265,000	276,000	265,000	**269,000**
Q_s	Volumetric flow rate, standard (scfm)	224,000	234,000	230,000	**229,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	175,000	183,000	180,000	**179,000**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	38.57	39.23	37.77	**38.52**
%I	Isokinetic sampling (%)	101.7	106.3	99.7	**102.6**
Laboratory Data (Ion Chromatography)					
m_n	Total H2SO4 collected (mg)	10.3	11.3	6.9	
Sulfuric Acid Vapor (H2SO4) Results					
C_{sd}	H2SO4 Concentration (ppmdv)	2.84	3.06	1.93	**2.61**
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	6.18	6.55	4.05	**5.60**
$E_{T/yr}$	H2SO4 Rate (Ton/yr)	27.08	28.71	17.73	**24.51**

RESULTS

Table 2-3:
FCCU Regenerator Vent – VOC, Condition 1

Run No.		4	5	6	7	Average
Date (2014)		Mar 21	Mar 21	Mar 21	Mar 21	
Start Time (approx.)		08:34	10:30	12:51	14:08	
Stop Time (approx.)		09:54	11:40	13:52	15:11	
Process Conditions						
R_P	Production Rate (MW/gross)	70.0	70.3	71.0	71.2	**70.7**
P_1	L/G	18.0	18.0	18.0	18.0	**18.**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760	**8,760**
Gas Conditions						
O_2	Oxygen (dry volume %)	3.3	1.1	0.9	1.0	**1.7**
CO_2	Carbon Dioxide (dry volume %)	16.8	18.9	19.1	19.1	**18.4**
Gas Flow Rate						
Q_a	Volumetric flow rate, actual (acfm)	265,000	276,000	265,000	272,000	**267,000**
Q_s	Volumetric flow rate, standard (scfm)	224,000	234,000	230,000	231,000	**229,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	175,000	183,000	180,000	181,000	**178,000**
Total Hydrocarbon Results						
C_w	THC Concentration (ppmwv)	2.49	2.44	2.10	0.99	**1.86**
$E_{lb/hr}$	THC Rate (lb/hr)	2.99	3.06	2.60	1.23	**2.27**
$E_{T/y}$	THC Rate (Ton/yr)	13.11	13.40	11.37	5.41	**9.96**

Average includes 3 runs. Run 5 not included.

Table 2-4:
FCCU Regenerator Vent – HCN, Condition 1

Run No.		1	2	3	8	Average
Date (2014)		Mar 18	Mar 18	Mar 19	Mar 21	
Start Time (approx.)		10:45	17:56	09:14	08:23	
Stop Time (approx.)		12:01	19:09	10:23	09:32	
Process Conditions						
R_P	Coke Burn Rate (MPPH)	69.7	70.7	70.1	69.9	**70.2**
P_1	L/G	18.1	18.	18.7	18.	**18.2**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760	**8,760**
Gas Conditions						
O_2	Oxygen (dry volume %)	2.7	2.9	3.7	2.3	**2.9**
CO_{2out}	Carbon dioxide at the outlet of the sampling train (dry volume %)	13.5	13.8	11.7	13.4	**13.1**
CO_{2in}	Carbon dioxide in the stack (dry volume %)	17.5	17.4	17.5	17.5	**17.5**
T_s	Sample temperature (°F)	143	143	144	143	**143**
B_w	Actual water vapor in gas from concurrent USEPA Method 4 test (% by volume)	21.98	22.07	21.58	18.82	**21.11**
Gas Flow Rate						
Q_a	Volumetric flow rate, actual (acfm)	268,000	264,000	272,000	265,000	**267,000**
Q_s	Volumetric flow rate, standard (scfm)	232,000	229,000	237,000	224,000	**231,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	181,000	178,000	185,000	175,000	**180,000**
Hydrogen Cyanide (HCN) Results						
C_{sd}	HCN Concentration (ppmdv)	26.99	31.35	25.03	31.93	**28.82**
C_{sd7}	HCN Concentration @7% O2 (ppmdv)	20.61	24.21	20.23	23.86	**22.23**
$E_{lb/hr}$	HCN Rate (lb/hr)	20.54	23.53	19.46	23.51	**21.76**
$E_{T/y}$	HCN Rate (Ton/yr)	89.98	103.04	85.25	102.96	**95.31**

Average includes 3 runs. Run 1 w as not included.

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RESULTS

Table 2-5:
FCCU Regenerator Vent – $PM_{10}/PM_{2.5}$, Condition 2

Run No.		4	5	6	Average
Date (2014)		Mar 19	Mar 19	Mar 19	
Start Time (approx.)		11:23	13:27	15:31	
Stop Time (approx.)		12:32	14:38	16:41	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	70.5	70.4	70.7	**70.6**
P_1	L/G	20.8	20.8	20.8	**20.8**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	4.3	2.8	1.4	**2.8**
CO_2	Carbon dioxide (dry volume %)	15.1	16.8	17.9	**16.6**
T_s	Sample temperature (°F)	145	145	144	**145**
B_w	Actual water vapor in gas (% by volume)	20.2	19.9	21.4	**20.5**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	277,000	287,000	274,000	**279,000**
Q_s	Volumetric flow rate, standard (scfm)	242,000	250,000	239,000	**243,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	188,000	195,000	186,000	**190,000**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	39.26	38.52	37.46	**38.41**
%I	Isokinetic sampling (%)	98.8	101.6	102.2	**100.9**
Laboratory Data					
m_n	Total FPM (g)	0.02013	0.02019	0.02033	
m_{CPM}	Total CPM (g)	0.00485	0.00653	0.00446	
m_{Part}	Total particulate (as pm10 & pm2.5) (g)	0.02498	0.02672	0.02479	
FPM Results					
$E_{lb/hr}$	Particulate Rate (lb/hr)	12.78	13.52	13.37	**13.22**
$E_{T/y}$	Particulate Rate (Ton/yr)	55.96	59.22	58.58	**57.92**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.18	0.19	0.19	**0.19**
CPM Results					
$E_{(lb/hr}$	Particulate Rate (lb/hr)	3.08	4.37	2.93	**3.46**
$E_{T/y}$	Particulate Rate (Ton/yr)	13.49	19.16	12.84	**15.16**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.04	0.06	0.04	**0.05**
Total Particulate (as PM10 & PM2.5) Results					
$E_{lb/hr}$	Particulate Rate (lb/hr)	15.86	17.90	16.30	**16.69**
$E_{T/y}$	Particulate Rate (Ton/yr)	69.45	78.38	71.41	**73.08**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.22	0.25	0.23	**0.24**

Average includes 3 runs.

[1]Gas Flow Rate calculated using M2F and 2H test runs.

RESULTS

Table 2-6:
FCCU Regenerator Vent – H_2SO_4 , Condition 2

Run No.		1	2	3	Average
Date (2014)		Mar 20	Mar 20	Mar 20	
Start Time (approx.)		09:31	11:55	13:26	
Stop Time (approx.)		10:50	13:02	14:32	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	70.3	70.2	70.3	**70.3**
P_1	L/G	21.8	21.8	21.9	**21.8**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	2.8	1.9	1.7	**2.1**
CO_2	Carbon dioxide (dry volume %)	17.1	17.8	18.0	**17.6**
T_s	Sample temperature (°F)	144	144	144	**144**
B_w	Actual water vapor in gas (% by volume)	20.93	21.27	20.37	**20.86**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	259,000	252,000	245,000	**252,000**
Q_s	Volumetric flow rate, standard (scfm)	224,000	220,000	215,000	**220,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	175,000	172,000	168,000	**172,000**
***Sampling* Data**					
V_{mstd}	Volume metered, standard (dscf)	37.59	38.73	37.25	**37.85**
%I	Isokinetic sampling (%)	101.8	103.3	100.7	**102.0**
Laboratory Data (Ion Chromatography)					
m_n	Total H2SO4 collected (mg)	18.0	14.0	15.1	
Sulfuric Acid Vapor (H2SO4) Results					
C_{sd}	H2SO4 Concentration (ppmdv)	5.08	3.84	4.30	**4.41**
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	11.09	8.23	9.01	**9.44**
$E_{T/yr}$	H2SO4 Rate (Ton/yr)	48.56	36.03	39.47	**41.35**

RESULTS

Table 2-7:
FCCU Regenerator Vent – VOC, Condition 2

Run No.		1	2	3	Average
Date (2014)		Mar 20	Mar 20	Mar 20	
Start Time (approx.)		09:07	13:07	14:20	
Stop Time (approx.)		10:17	14:09	15:22	
Process Conditions					
R_P	Production Rate (MW/gross)	70.2	70.2	70.6	**70.3**
P_1	L/G	21.8	21.8	21.8	**21.8**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	1.3	1.2	1.1	**1.2**
CO_2	Carbon Dioxide (dry volume %)	18.8	18.8	18.9	**18.8**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	259,000	245,000	242,000	**249,000**
Q_s	Volumetric flow rate, standard (scfm)	224,000	215,000	211,000	**216,000**
Q_{sd}	Volumetric flow rate, dry standard (dscfm)	175,000	168,000	165,000	**169,000**
Total Hydrocarbon Results					
C_a	THC Concentration (ppmwv)	3.56	3.11	2.64	**3.10**
$E_{lb/hr}$	THC Rate (lb/hr)	4.27	3.58	2.99	**3.61**
$E_{T/yr}$	THC Rate (Ton/yr)	18.70	15.68	13.09	**15.82**

Table 2-8:
FCCU Regenerator Vent – HCN, Condition 2

Run No.		4	5	6	7	Average
Date (2014)		Mar 19	Mar 19	Mar 19	Mar 20	
Start Time (approx.)		11:23	13:27	15:31	09:31	
Stop Time (approx.)		12:32	14:38	16:41	11:11	
Process Conditions						
R_P	Production Rate (MW/gross)	70.5	70.4	70.7	70.3	**70.5**
P_1	L/G	20.8	20.8	20.8	21.8	**21.1**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760	**8,760**
Gas Conditions						
O_2	Oxygen (dry volume %)	10.0	2.3	1.8	3.6	**2.6**
CO_{2out}	Carbon dioxide at the outlet of the sampling train (dry volume %)	7.0	12.5	13.0	11.3	**12.3**
CO_{2in}	Carbon dioxide in the stack (dry volume %)	15.1	16.8	17.9	18.0	**16.6**
T_s	Sample temperature (°F)	144	143	143	143	**143**
B_w	Actual water vapor in gas from concurrent USEPA Method 4 test (% by volume)	20.19	19.86	21.42	20.37	**20.55**
Gas Flow Rate						
Q_a	Volumetric flow rate, actual (acfm)	277,000	287,000	274,000	259,000	**273,000**
Q_s	Volumetric flow rate, standard (scfm)	242,000	250,000	239,000	224,000	**237,000**
Q_{sd}	Volumetric flow rate, dry standard (dscfm)	188,000	195,000	186,000	175,000	**185,000**
Hydrogen Cyanide (HCN) Results						
C_{sd}	HCN Concentration (lb/dscf)	1.44E-06	1.61E-06	1.58E-06	1.56E-06	**1.58E-06**
$E_{lb/hr}$	HCN Rate (lb/hr)	16.22	18.84	17.71	16.32	**17.62**
$E_{T/yr}$	HCN Rate (Ton/yr)	71.04	82.50	77.56	71.49	**77.19**

Average includes 3 runs. Run 4 w as not included.

End of Section 2 – Results

DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

MPC's facility, located in Garyville, Louisiana, produces refined petroleum products from crude oil.

The Fluidized Catalytic Cracking Unit (FCCU) converts gas oil into gasoline and other hydrocarbons. Hydrotreated heavy gas oil is contacted with silica alumina catalyst at the base of the reactor riser. The oil is cracked and the reactor stream tops are diverted to a fractionator. During the cracking process, coke is deposited on the catalyst requiring it to be continuously regenerated and contacted with air at approximately 1,350° F to burn the coke off the catalyst. The regenerator flue gas is sent to a wet scrubber, while the catalyst is recycled.

The testing described in this document will be performed at FCC Regenerator Vent Stack.

DESCRIPTION OF SAMPLING LOCATION

Sampling point locations were determined according to EPA Method 1 and 2H, where applicable.

Table 3-1 outlines the sampling point configurations. The figure shown on page 3-2 illustrates the sampling points and orientation of sampling ports for each of the sources tested in the program.

Table 3-1:
Sampling Points

Source Constituent	Method (USEPA)	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
FCC Regenerator Stack							
FPM / CPM	M-5/202	1-6	4	6	2.5	60	3-1
HCN	OTM-29	1-8	4	6	2.5	60	3-1
H_2SO_4	M-8	1-6	4	6	2.5	60	3-1
O_2 / CO_2 / VOC / THC	M-3A / 18 / 25A	1-7	1	1	60	60	N/A[1]
Flow Rate	M-2F	1-17	4	6	varies	varies	3-1
Velocity Decay	M-2H	1-4	4	11	varies	varies	3-2

[1] Sampling occurs at a single point near the center of the stack.

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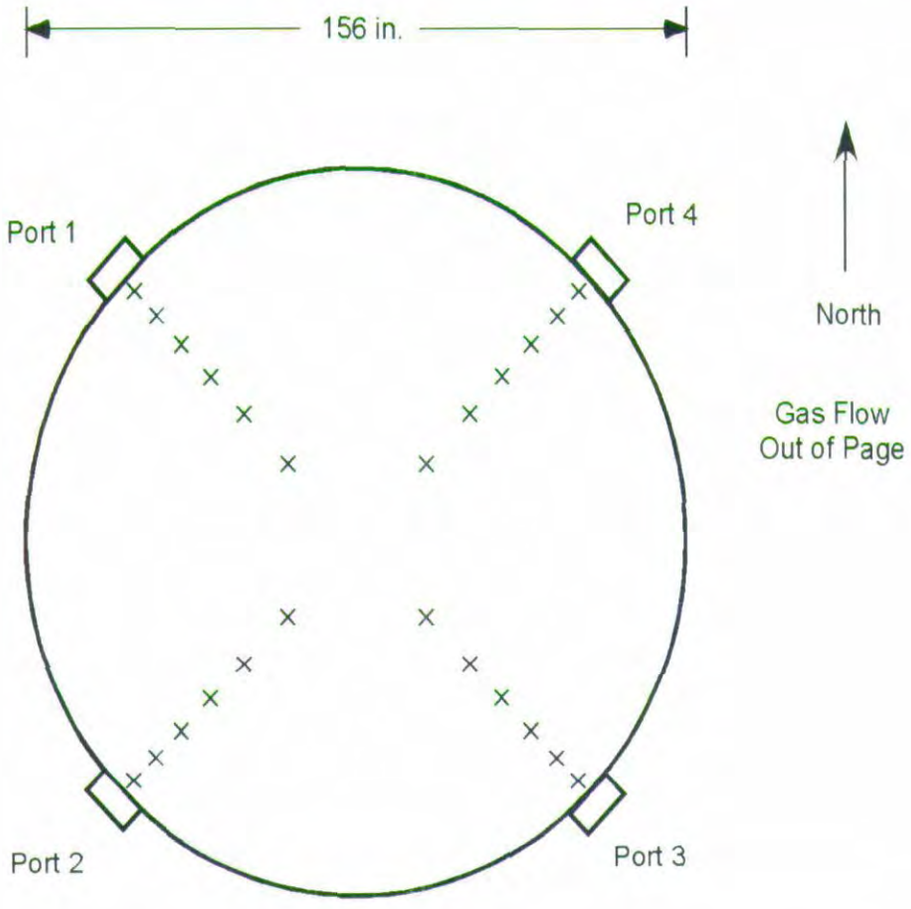
DESCRIPTION OF INSTALLATION



Sampling Point	Port to Point Distance (in.)
1	55.5
2	39.0
3	27.6
4	18.4
5	10.5
6	3.3

Duct diameters upstream from flow disturbance (A):	4.2	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	4.0	Limit: 2.0

Figure 3-1: FCC Regenerator Stack Sampling Points (Method 5/202, 8, & 2F, OTM-29)

Table 3-2:
FCC Regenerator Stack Wall Effects Sampling Points

Traverse Point	Port to Point Distance (in.)
1	55.5
2	39.0
3	27.6
4	18.4
5	10.5
6	6.0
7	5.0
8	4.0
9	3.3
10	2.0
11	1.0

End of Section 3 – Description of Installation

METHODOLOGY

Clean Air Engineering will follow procedures as detailed in EPA Methods 1, 2, 2F, 2H, 3, 3A, 4, 5, 8, 18, 25A, 202, and Other Test Method (OTM) 29. The following table summarizes the methods and their respective sources.

Table 4-1:
Summary of Sampling Procedures

Title 40 CFR Part 60 Appendix A	
Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
Method 2F	"Determination of Stack Gas Velocity And Volumetric Flow Rate with Three-Dimensional Probes"
Method 2H	"Determination of Stack Gas Velocity Taking into Account Velocity Decay near the Stack Wall"
Method 3	"Gas Analysis for the Determination of Dry Molecular Weight"
Method 3A	"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)"
Method 4	"Determination of Moisture Content in Stack Gases"
Method 5	"Determination of Particulate Matter Emissions from Stationary Sources"
Method 8	"Determination of Sulfuric Acid and Sulfur Dioxide Emissions from Stationary Sources"
Method 18	"Measurement of Gaseous Organic Compound Emissions by Gas Chromatography"
Method 25A	"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"
Title 40 CFR Part 51 Appendix M	
Method 202	"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"
Other Test Methods	
OTM-29	"Sampling and Analysis for Hydrogen Cyanide Emissions from Stationary Sources"

These methods appear in detail in Title 40 of the Code of Federal Regulations (CFR) and are located on the internet at http://ecfr.gpoaccess.gov.

Diagrams of the sampling apparatus and major specifications of the sampling, recovery and analytical procedures are summarized for each method in Appendix A.

CleanAir followed specific quality assurance and quality control (QA/QC) procedures as outlined in the individual methods and as prescribed in CleanAir's internal Quality Manual. Results of all QA/QC activities performed by CleanAir are summarized in Appendix D.

End of Section 4 – Methodology

APPENDIX

TEST METHOD SPECIFICATIONS ..... A
SAMPLE CALCULATIONS ..... B
PARAMETERS C
QA/QC DATA ..... D
FIELD DATA ..... E
FIELD DATA PRINTOUTS ..... F
LABORATORY DATA ..... G
MONITOR DATA ..... H
PLANT DATA I
PROTOCOL ..... J
PERTINENT CERTIFICATIONS ..... K

TEST METHOD SPECIFICATIONS

A

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: AWK

Date: 05/14

CleanAir

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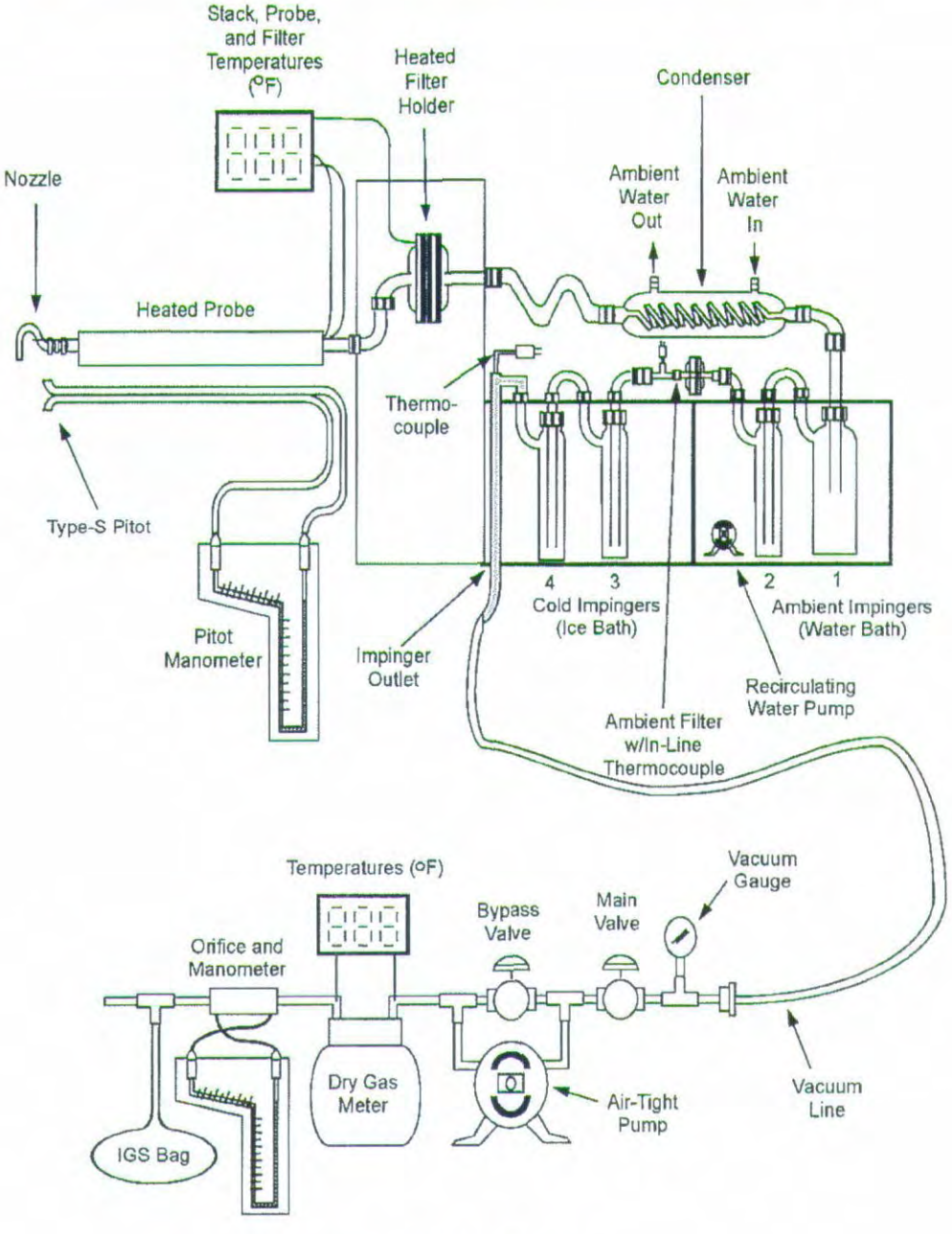
EPA Method 5/202
Sampling Train Configuration



Impinger Contents

Impinger 1	Empty
Impinger 2	Empty
Impinger 3	DI H_2O
Impinger 4	Silica Gel

Specification Sheet for EPA Method 5/202

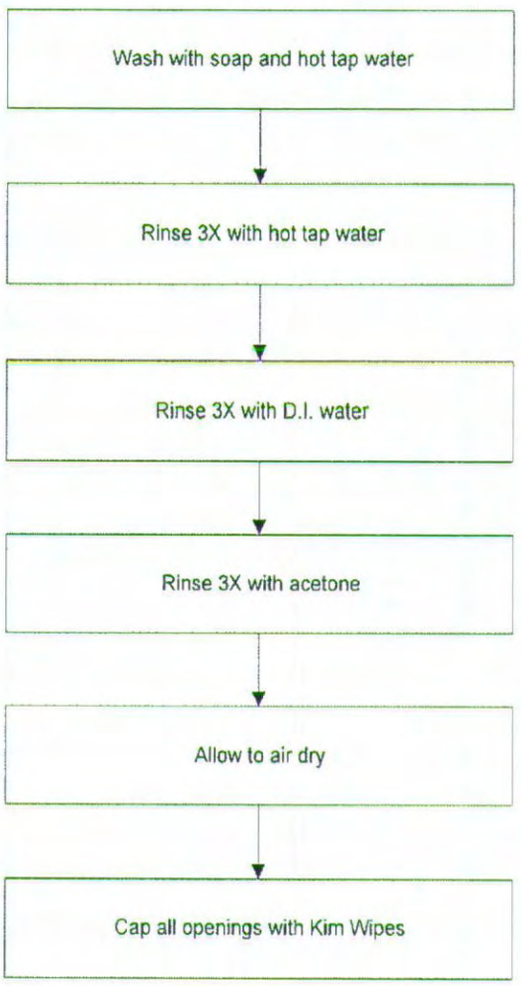
Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	Filterable Particulate Matter (FPM) and Condensable Particulate Matter (CPM)
Other Parameters to be Determined from Train	Gas Density, Moisture, Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	24
Sample Time per Point	N/A	2.5 minutes
Sampling Rate	Isokinetic (90-110%)	Isokinetic (90-110%)
Sampling Probe		
Nozzle Material	Stainless Steel or Glass	Borosilicate Glass
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Glass or Teflon	Borosilicate Glass
Effective Probe Length	N/A	6 feet
Probe Temperature Set-Point	248°F±25°F	248°F±25°F
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	N/A	0.831
Pitot Tube Calibration by	Geometric or Wind Tunnel	Wind-Tunnel
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
FPM Filter Description		
Filter Location	After Probe	Exit of Probe
Filter Holder Material	Quartz	Borosilicate Glass
Filter Support Material	Glass Frit	Teflon
Cyclone Material	N/A	None
Filter Heater Set-Point	248°F±25°F	248°F±25°F
Filter Material	Glass Fiber	Quartz Fiber
Other Components		
Description	Condenser	Condenser
Location	Before Impinger 1	Before 1st Impinger
Operating Temperature	≤85°F	≤85°F

Specification Sheet for EPA Method 5/202

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Leak-Free Glass Connectors	Screw Joint with Silicone Gasket
Connection to Probe or Filter by	Direct or Flexible Connection	Direct Glass Connection
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Shortened Stem (open tip)	Shortened Stem (open tip)
Impinger 2	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 3	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 4	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 5		
Impinger 6		
Impinger 7		
Impinger 8		
CPM Filter Description		
Filter Location	Between 2nd and 3rd Impingers	Between 2nd and 3rd Impingers
Filter Holder Material	Glass, Stainless Steel or Teflon	Borosilicate Glass
Filter Support Material	Teflon	Teflon
Cyclone Material	None	None
Filter Heater Set-Point	>65°F but ≤85°F	>65°F but ≤85°F
Filter Material	Teflon Membrane	Teflon Membrane
Gas Density Determination		
Sample Collection	Multi-point integrated	Multi-Point Integrated
Sample Collection Medium	Flexible Gas Bag	Vinyl Bag
Sample Analysis	Orsat or CEM Analyzer	CEM
Sample Recovery Information		
Nozzle Brush Material	Nylon Bristle or Teflon	Nylon Bristle
Nozzle Rinse Reagent	Acetone	Acetone
Nozzle Rinse Wash Bottle Material	Glass or Polyethylene	Inorganic in polyethylene, organic in Teflon
Nozzle Rinse Storage Container	Glass or Polyethylene	Glass
Filter Recovered?	Yes	Yes
Filter Storage Container	FH filter in petri dish, CPM filter in petri dish	FH filter in petri dish, CPM filter in petri dish
Impinger Contents Recovered?	Yes	Yes
Impinger Rinse Reagent	DI Water/Acetone/Hexane	DI Water/Acetone/Hexane
Impinger Wash Bottle	Inorganic in polyethylene, organic in Teflon	Inorganic in polyethylene, organic in Teflon
Impinger Storage Container	Inorganic in polyethylene, organic in glass	Inorganic in amber glass, organic in amber glass
Analytical Information		
Method 4 H_2O Determination by	Volumetric or Gravimetric	Gravimetric and Volumetric
Filter Preparation Conditions	Dessicate 24 Hours or Filter Extraction	See Analytical Flow Chart
Front-Half Rinse Preparation	Evaporate at ambient temperature and pressure	Evaporate at ambient temperature and pressure
Back-Half Analysis	Sonication and Extraction	See Analytical Flow Chart
Additional Analysis	N/A	None

EPA Method 5
Glassware Preparation Procedures



EPA Method 5
Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)

Container 1
Quartz Filter
Petri Dish

Remove with tweezers to original container. Brush any loose particulate or filter fibers into sample container

If necessary fold in half and place into container

Visual Inspection

Container 2
Front Half (FH) Rinse
250 ml Glass

Probe liner, nozzle, cyclone or cyclone bypass and filter FH

Brush/rinse 3X with acetone (6X for metal components)

Visual Inspection

Label container and measure volume by weight

Container 3
Silica Gel

Measure volume by weight, note any color change

Recycle silica gel

*Containers 4 and 7 are required when the testing includes a back half analysis

Container 4*
Back Half (BH) Rinse
500 ml Plastic

BH filter housing, Z-piece, impingers 1, 2, 3 and U-Bends

Measure volume by weight

Empty contents into labeled container

Rinse with water

Visual Inspection

Label container and measure volume by weight

Blanks

Container 5
Filter Blank
Plastic Petri Dish

Clean, unused tared filter

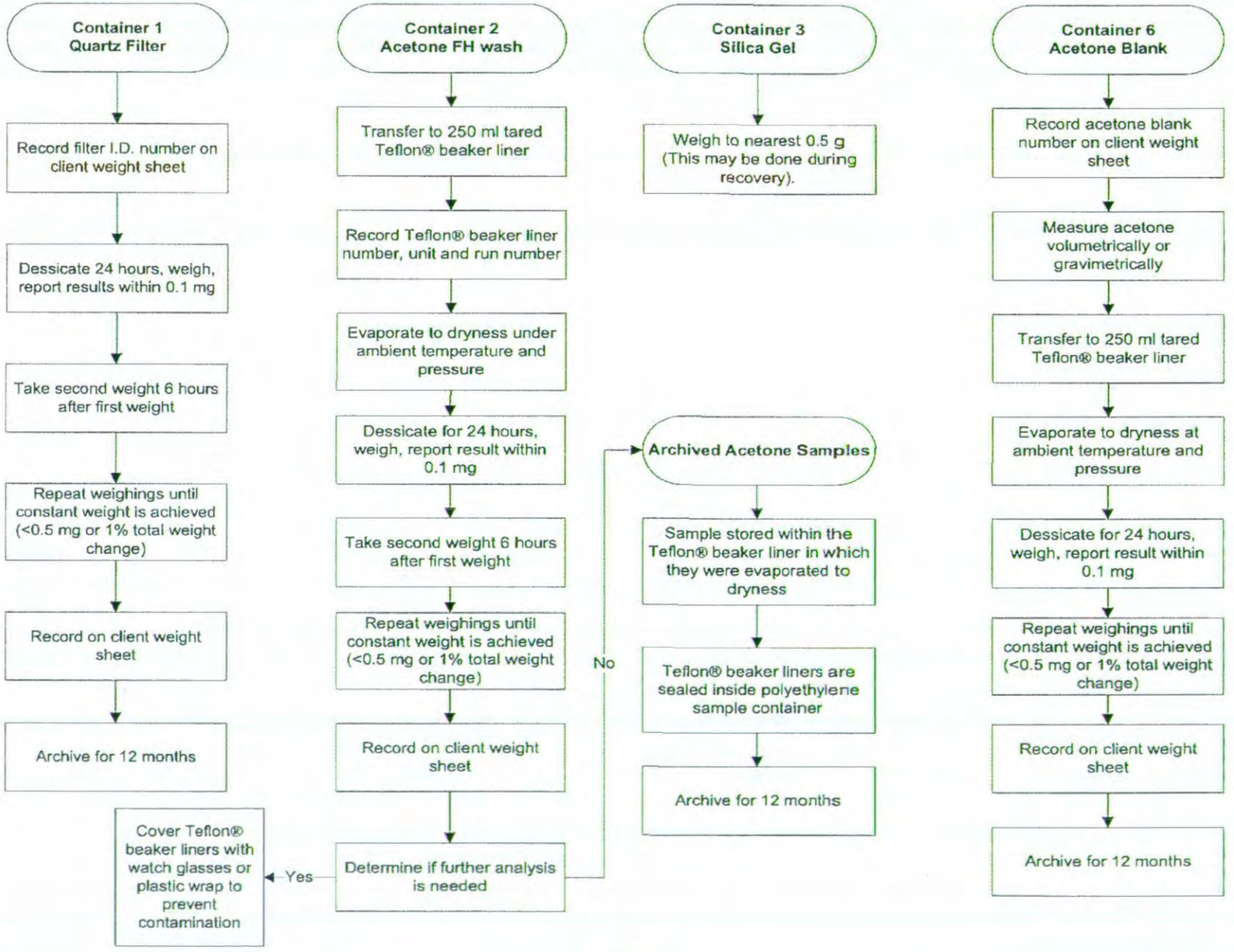
Container 6
Acetone Blank
250 ml Glass

200 ml of acetone from rinse bottle. Record lot number

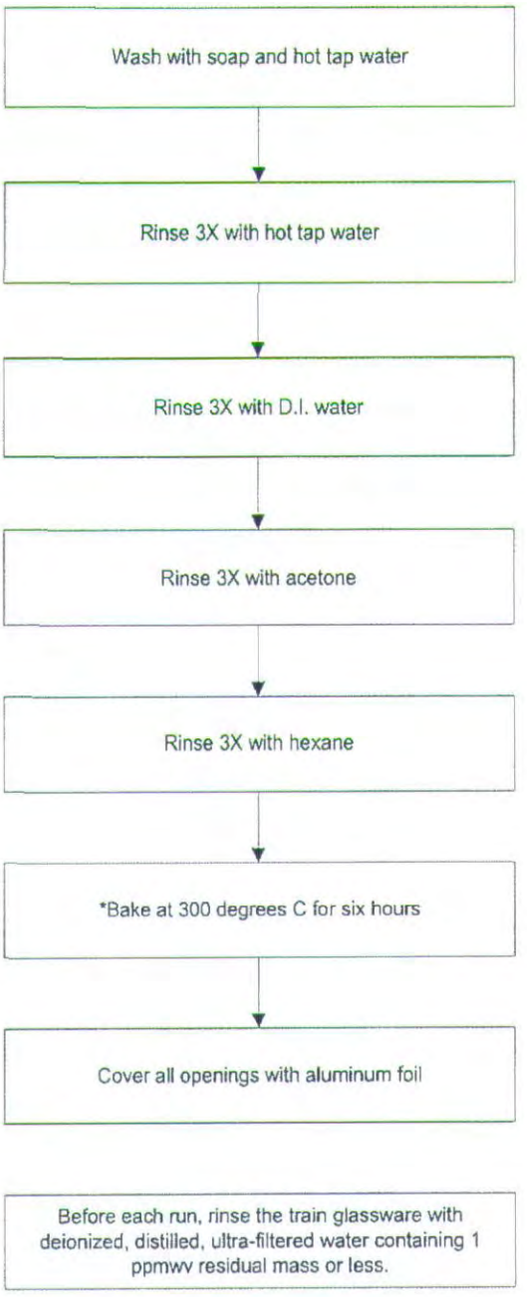
Container 7*
D.I. Water Blank
250 ml Plastic

200 ml of water from rinse bottle

EPA Method 5
Analytical Flowchart



EPA Method 202
Glassware Preparation Procedures



*As an alternative to baking glassware, a field train proof blank can be performed on the sampling train glassware.

EPA Method 202
Sample Recovery Flowchart (1 of 2)

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degreesC)
- Samples must be maintained at or below 85 degrees F (30 degrees C) during shipping.

Post-Test N2 Purge*

Transfer water collected in condenser and water dropout impinger to back-up impinger; measure and record volume or weight

Conduct purge on condenser, back-up impinger and CPM filter with N2 at 14 LPM for one hour

Purge Notes:

- *Continue operating condenser recirculation pump and maintain gas temperature at exit of CPM filter >65°F but ≤85°F.*
- *If volume of water in moisture traps was not determined prior to purge, maintain trap temperature and keep gas temperature at exit of silica gel impinger below 68°F.*
- *At conclusion of purge, simultaneously turn off delivery and pumping systems.*
- *For high moisture sampling, weigh and change out silica gel prior to purging.*

CPM Container 1
Inorganic Rinse
950 ml Amber Glass

Back-half FPM filter holder, probe extension, condenser, dropout and back-up impingers, connecting glassware, front-half CPM filter holder

Measure and record impinger volume by weight

Empty contents into labeled container

Rinse 2X with deionized, distilled, ultra-filtered water and add to sample container

Visual Inspection

Mark liquid level and label container

CPM Container 2
Organic Rinses
950 ml Amber Glass

Back-half FPM filter holder, probe extension, condenser, dropout and back-up impingers, connecting glassware, front-half CPM filter holder

Rinse 1X with acetone and add to sample container

Rinse 2X with hexane and add to sample container

Visual Inspection

Mark liquid level and label container

CPM Container 3
Filter Sample
Petri Dish

CPM filter

Use tweezers and/or disposable surgical gloves to remove CPM filter and place in Petri dish

Visual Inspection

Label container

CPM Container 4**
Cold Impinger Water
500 ml Plastic

Cold impinger that follows the CPM filter

Quantitatively transfer liquid into sample container

Visual Inspection

Mark liquid level and label container

****If the water has been weighed in the field, it can be discarded.**

CPM Container 5
Silica Gel

Measure volume by weight, note any color change

Recycle silica gel

EPA Method 202
Sample Recovery Flowchart (2 of 2)

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)
- Samples must be maintained at or below 85 degrees F (30 degrees C) during shipping.

CPM Container 6 Acetone Field Reagent Blank

Collect 200 ml of acetone from wash bottle into amber glass container

Visual inspection

Mark liquid level and label container

Collect one acetone blank for each lot of solvent used

CPM Container 7 Water Field Reagent Blank

Collect 200 ml of water from wash bottle into amber glass container

Visual inspection

Mark liquid level and label container

Collect one water blank for each lot used

CPM Container 8 Hexane Field Reagent Blank

Collect 200 ml of hexane from wash bottle into amber glass container

Visual inspection

Mark liquid level and label container

Collect one hexane blank for each lot of solvent used

CPM Container 9 Field Train Proof Blank* Inorganic Rinses

Prior to testing, rinse probe extension, condenser, impingers, connecting glassware and front-half CPM filter housing 2X with water

Collect rinses in plastic sample container

Visual inspection

Mark liquid level and label container

If glass ware was not baked a field train proof blank must be performed to demonstrate the cleanliness of the glassware. Baking the glassware is a CleanAir SOP

CPM Container 10 Field Train Proof Blank* Organic Rinses

After rinsing with water, rinse probe extension, condenser, impingers, connecting glassware and front-half CPM filter housing with acetone

Repeat procedure by rinsing 2X with hexane

Collect both rinses in amber glass container

Visual inspection

Mark liquid level and label container

Field Train Blank (required)

A minimum of one field train blank for each source category tested at facility is required.

Recover field blank after first or second run

Assemble sampling train as it would be used for testing.

Prior to purge, add 100 ml water to first impinger and record data

Purge train and recover blank samples as described on Page 1 of 2

From field sample weight, subtract condensable particulate mass determined from blank train or 0.002 g, whichever is less.

EPA Method 202
Analytical Flowchart (1 of 2)

- Log each sample in shipment and verify against chain-of-custody sheet
- Note liquid levels in the sample containers and confirm on the chain-of-custody sheet condition

CPM Container 1 Inorganic Rinse

Measure liquid volumetrically or gravimetrically

Transfer inorganic contents into separatory funnel and add 30 ml of hexane

Drain off lower inorganic phase into a clean sample container or beaker

Drain off organic phase into a separate clean sample container or beaker, leaving a small amount of hexane in funnel

Repeat procedure twice with 30 ml hexane, combining the organic phase with each extraction

Inorganic Extraction

Transfer inorganic fraction from extraction into 250 ml tared Teflon® beaker liner

Evaporate to no less than 10 ml on a hot plate or in 105 degree C oven

Allow to dry at room temperature (not to exceed 85 degrees F). Ensure the water and volatile acids have completely evaporated before neutralizing nonvolatile acids in sample

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

No constant weight

Redissolve residue in 100 ml of deionized, distilled ultra-filtered water

Titrate sample with 0.1 N NH_4OH to a pH of 7.0, record volume of titrant used.

Evaporate to no less than 10 ml using hot plate or 105 degree C oven

Allow to dry at room temperature (not to exceed 85 degrees F)

Organic Extraction

The extraction should yield around 90 ml of organic extract

Combine the organic extract of Container 1 with the organic train rinse in Container 2

CPM Container 2 Organic Rinses

Measure liquid volumetrically or gravimetrically

Transfer contents into 250 ml tared Teflon® beaker liner

Evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

CPM Container 3 Filter Sample

Was sample collected by Method 17 or 201A with a stack temp < 85°F? Can the filter be brought to constant weight?

Yes

Transfer filter and loose PM from sample container to tared glass weighing dish

Dessicate for 24 hours

Weigh to constant weight and report results to nearest 0.1 mg

No

Extract the filter

Inorganic Extraction

Fold filter into quarters and place in 50 ml extraction tube

Add 10 ml deionized, distilled ultra-filtered water to extraction tube (or sufficient to cover the filter)

Extract for at least 2 minutes in sonication bath; add to separate inorganic fraction Container 1

Repeat extraction twice more for a total of three extractions; add to Container 1

Organic Extraction

Add 10 ml hexane to extraction tube (or sufficient to cover the filter)

Extract for at least 2 minutes in sonication bath; add to separate organic fraction Container 2

Repeat extraction twice more for a total of three extractions; add to Container 2

EPA Method 202
Analytical Flowchart (2 of 2)

- Log each sample in shipment and verify against chain-of-custody sheet
- Note liquid levels in the sample containers and confirm on the chain-of-custody sheet condition

CPM Container 4*
Cold Impinger Water

Measure liquid volumetrically or gravimetrically

CPM Container 5*
Silica Gel

Weigh to nearest 0.5 g

*May have been performed in the field during sample recovery

CPM Container 6
Acetone Field Reagent Blank

Transfer 150 ml of acetone to 250 ml tared Teflon® beaker liner and evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

CPM Container 7
Water Field Reagent Blank

Transfer 150 ml of water to 250 ml tared Teflon® beaker liner and evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

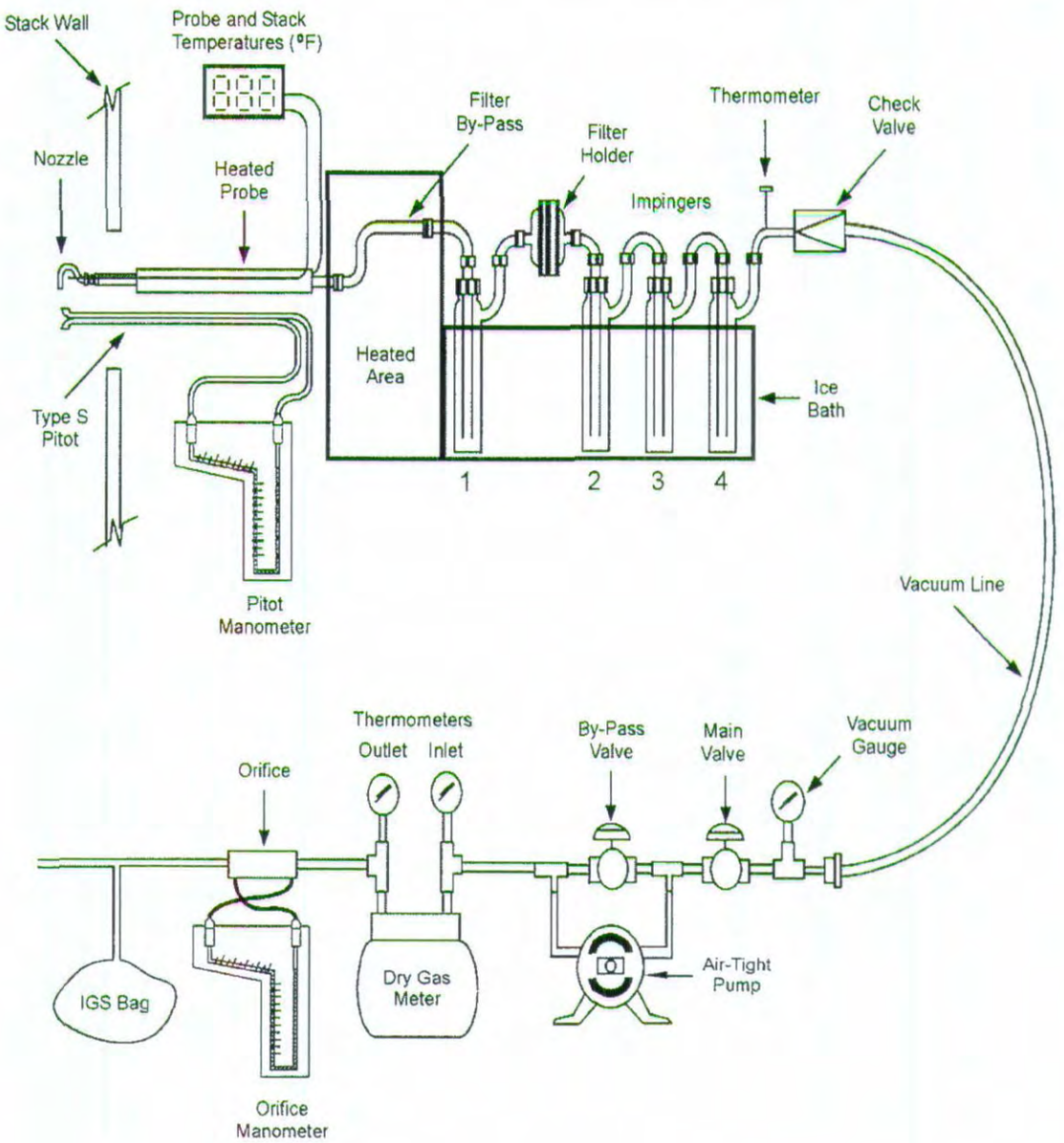
CPM Container 8
Hexane Field Reagent Blank

Transfer 150 ml of hexane to 250 ml tared Teflon® beaker liner and evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

EPA Method 8
Sampling Train Configuration



Impinger Contents

Impinger 1	100 ml 80% isopropanol
Impinger 2	100 ml DI
Impinger 3	100 ml DI
Impinger 4	Silica gel

Specification Sheet for EPA Method 8

Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	Sulfuric Acid Mist (H_2SO_4)
Other Parameters to be Determined from Train	Gas Density, Moisture, Flow Rate

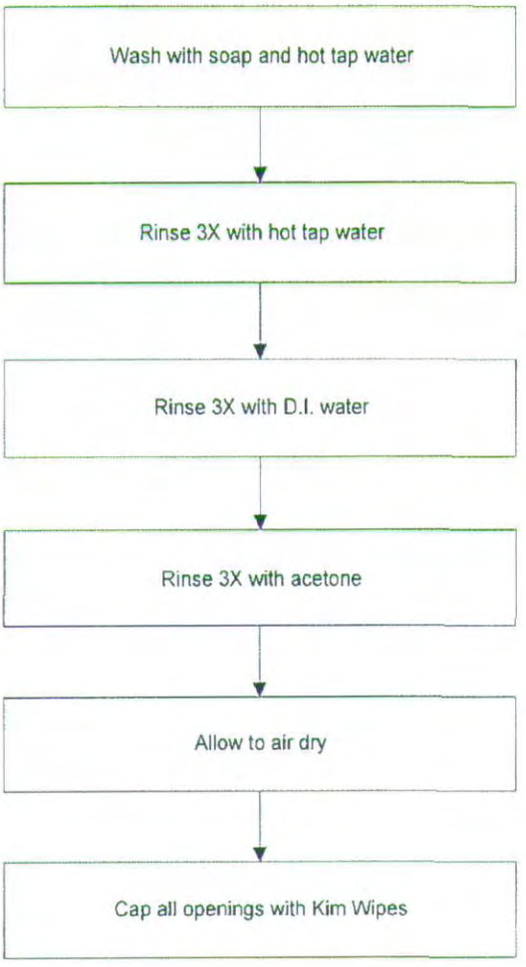
	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	24
Sample Time per Point	N/A	3 minutes
Sampling Rate	Isokinetic (90-110%) - 1 cfm maximum	Isokinetic (90-110%) - 1 cfm maximum
Sampling Probe		
Nozzle Material	Stainless Steel or Glass	Borosilicate Glass
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Borosilicate or Quartz Glass	Borosilicate Glass
Effective Probe Length	N/A	6 feet
Probe Temperature Set-Point	Prevent condensation	Prevent condensation
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	N/A	0.831
Pitot Tube Calibration by	Geometric or Wind Tunnel	Geometric
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	Between 1st and 2nd Impingers	Between 1st and 2nd Impingers
Filter Holder Material	Borosilicate Glass	Borosilicate Glass
Filter Support Material	Glass Frit (Teflon optional)	Teflon
Cyclone Material	N/A	None
Filter Heater Set-Point	Not Heated	N/A
Filter Material	Glass Fiber	Quartz Fiber
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

Specification Sheet for EPA Method 8

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Ground Glass or Equivalent	Screw Joint with Silicone Gasket
Connection to Probe or Filter by	Direct Glass Connection	Direct Glass Connection
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Greenburg-Smith	Greenburg-Smith
Impinger 2	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 3	Greenburg-Smith	Greenburg-Smith
Impinger 4	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 5		
Impinger 6		
Impinger 7		
Impinger 8		
Gas Density Determination		
Sample Collection	Multi-point integrated	Multi-Point Integrated
Sample Collection Medium	Flexible Gas Bag	Vinyl Bag
Sample Analysis	Orsat or Fyrite Analyzer	CEM
Sample Recovery Information		
Front-Half* Brush Material	None	N/A
Front-Half Rinse Reagent	80% Isopropanol	80% IPA
Front-Half Rinse Wash Bottle Material	Glass or Polyethylene	Polyethylene
Front-Half Rinse Storage Container	Polyethylene	Polyethylene
Filter Recovered?	Yes	Yes
Filter Storage Container	Filter added to front-half sample container.	Added to front-half sample container.
Impinger Contents Recovered?	Yes	Yes
Impinger Rinse Reagent	Deionized Distilled Water	Deionized Distilled Water
Impinger Wash Bottle	Glass or Polyethylene	Polyethylene
Impinger Storage Container	Polyethylene	Polyethylene
Analytical Information		
Method 4 H_2O Determination by	Gravimetric	Gravimetric
Filter Preparation Conditions	N/A	N/A
Front-Half Rinse Preparation	Titration for sulfate	Sulfate Analysis
Back-Half Analysis	Titration for sulfate	N/A
Additional Analysis	N/A	None

* Front-Half includes all sample components up to and including front-half of filter holder.

EPA Method 8
Glassware Preparation Procedures



EPA Method 8
Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)

Container 1
1000 ml HDPE

↓

Probe, impinger 1, connecting glassware, front half (FH) filter holder

↓

Record weight of impinger 1 and contents to nearest 0.5 g

↓

Transfer to 250 ml graduated cylinder

↓

Rinse each piece with 80% Isopropanol. Add to cylinder

↓

Dilute to 225 ml with 80% Isopropanol

↓

Transfer to storage container. Rinse cylinder with 25 ml of 80% IPA and transfer to storage container

↓

Add filter to container and mix

↓

Mark liquid level, seal, label sample container

Container 3
Silica Gel

↓

Measure volume by weight, note any color change

↓

Recycle silica gel

Container 4
80% IPA Blank + Filter
250 ml HDPE

↓

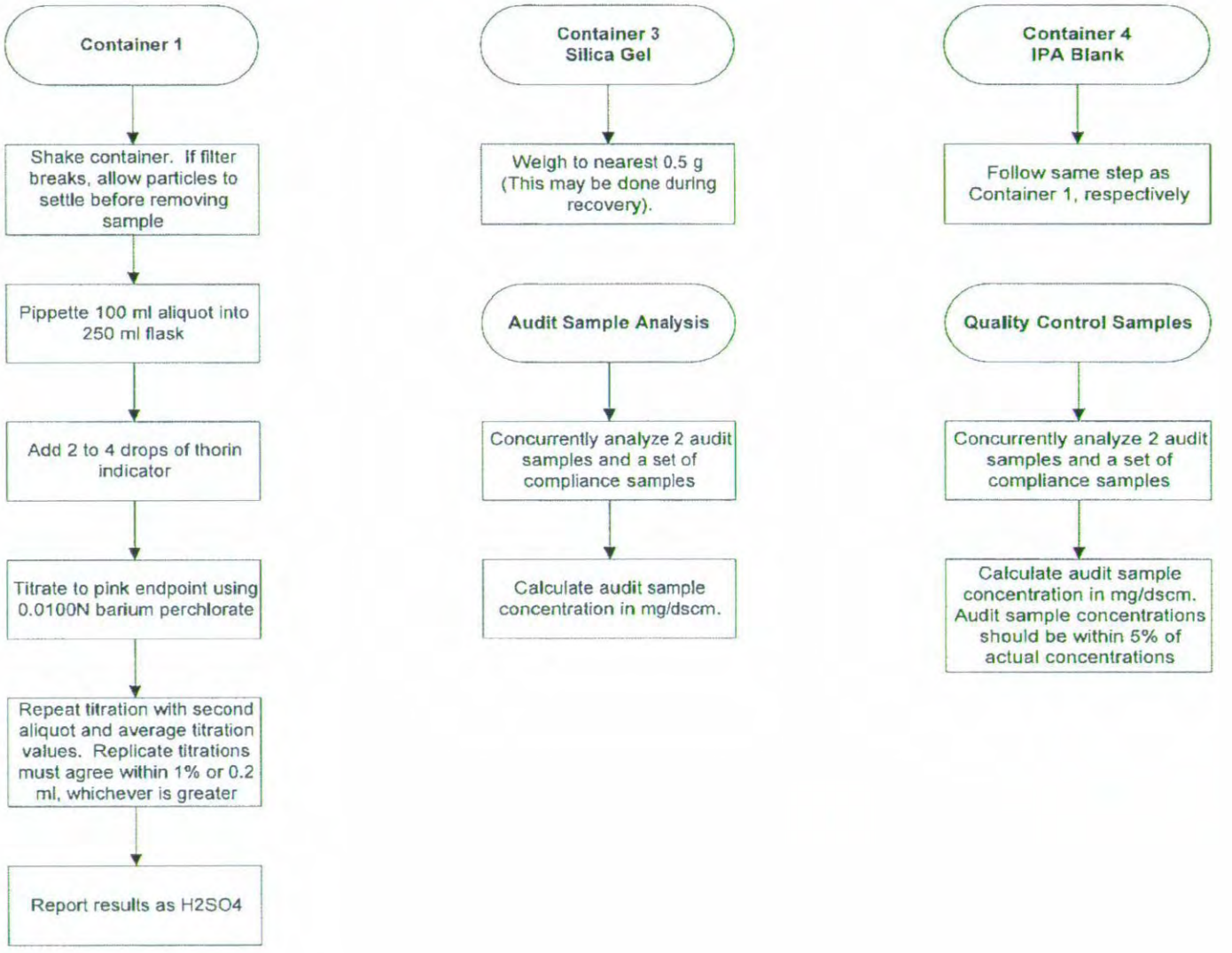
200 ml of 80% IPA from rinse bottle plus filter. Record lot numbers

Container 5
DI Water Blank
250 ml HDPE

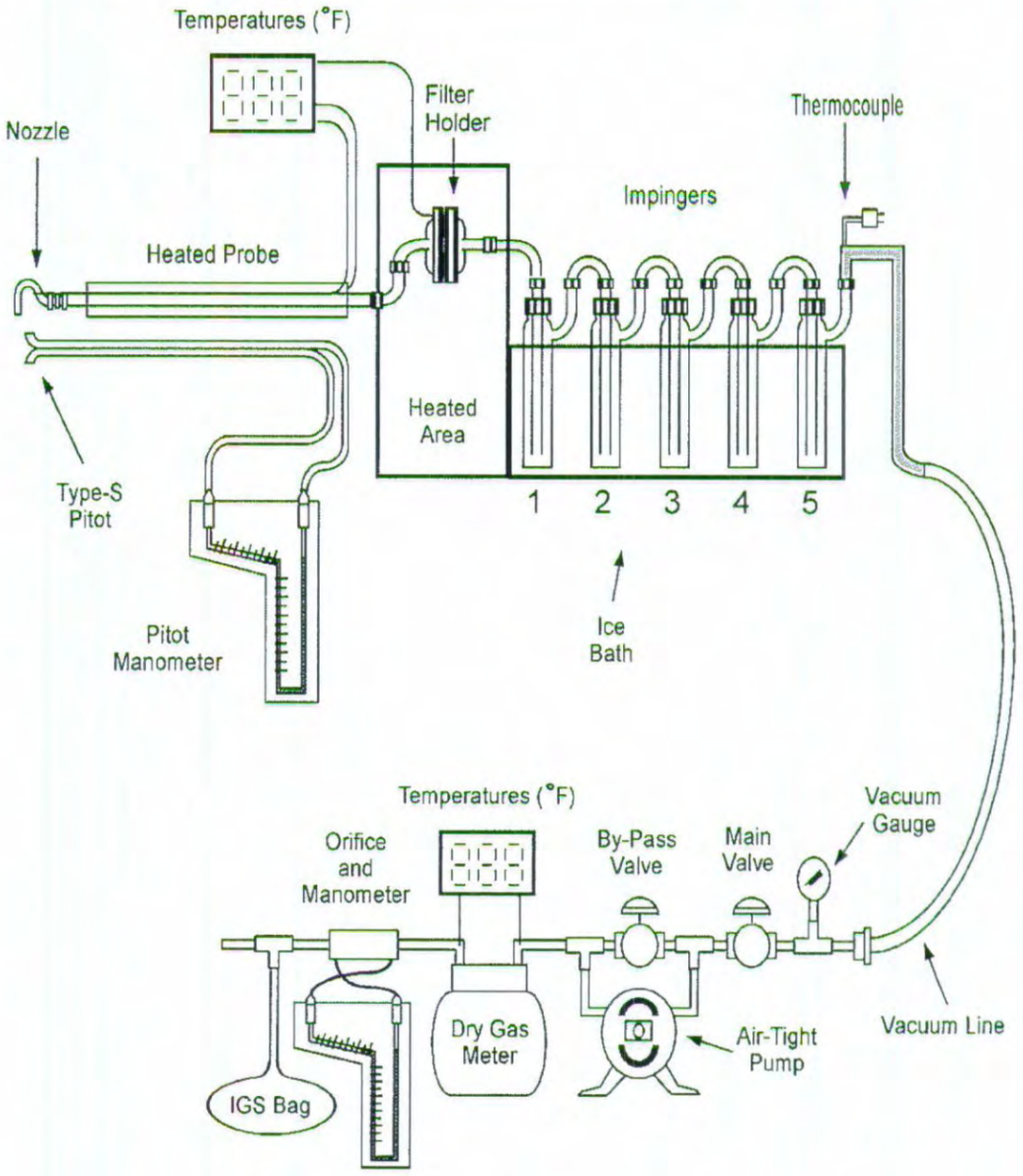
↓

200 ml of D.I. water from rinse bottle

EPA Method 8
Analytical Flowchart
(Sulfuric Acid Mist only)



Other Test Method 29
Sampling Train Configuration



Impinger Contents

Impinger 1	200 mL 6N NaOH
Impinger 2	200 mL 6N NaOH
Impinger 3	200 mL 6N NaOH
Impinger 4	100 mL 6N NaOH
Impinger 5	Silica Gel

Specification Sheet for Other Test Method 29

Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	Hydrogen Cyanide
Other Parameters to be Determined from Train	Gas Density, Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	24
Sample Time per Point	N/A	2.5 minutes
Sampling Rate	Isokinetic (90-110%)	Isokinetic (90-110%)
Sampling Probe		
Nozzle Material	Borosilicate or Quartz Glass	Borosilicate Glass
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Borosilicate or Quartz Glass	Borosilicate Glass
Effective Probe Length	N/A	6 feet
Probe Temperature Set-Point	248˚F ± 25˚F	248˚F±25˚F
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	Known coefficient	0.832
Pitot Tube Calibration by	Geometric or Wind Tunnel	Wind-Tunnel
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±2%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4˚F	5.4˚F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	After Probe	Exit of Probe
Filter Holder Material	Borosilicate, Quartz Glass	Borosilicate Glass
Filter Support Material	Teflon	Teflon
Cyclone Material	NA	None
Filter Heater Set-Point	248˚F ± 25˚F	248˚F±25˚F
Filter Material	Quartz or Fluoropolymer Coated Fiber Filter	Quartz Fiber
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

Specification Sheet for Other Test Method 29

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Ground Glass or Equivalent	Ground Glass with Silicone O-Ring
Connection to Probe or Filter by	Direct Glass Connection	Direct Glass Connection
Number of Impingers	4 or 5	5
Impinger Stem Types		
Impinger 1	Greenburg-Smith	Modified Greenburg-Smith
Impinger 2	Greenburg-Smith	Modified Greenburg-Smith
Impinger 3	Greenburg-Smith	Modified Greenburg-Smith
Impinger 4	Greenburg-Smith	Modified Greenburg-Smith
Impinger 5	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 6		
Impinger 7		
Impinger 8		
Gas Density Determination		
Sample Collection	Multi-point integrated	Multi-Point Integrated
Sample Collection Medium	Flexible Gas Bag	Direct Interface
Sample Analysis	Orsat or Fyrite Analyzer	CEM
Sample Recovery Information		
Probe Brush Material	Teflon Bristle	Teflon Bristle
Probe Rinse Reagent	Acetone	Acetone
Probe Rinse Wash Bottle Material	Teflon or glass	Teflon
Probe Rinse Storage Container	N/A	Glass
Filter Recovered?	Yes (for PM analysis only)	No
Filter Storage Container	N/A	Polyethylene
Impinger Contents Recovered?	Yes	Yes
Impinger Rinse Reagent	0.1N NaOH	0.1 N Sodium Hydroxide
Impinger Wash Bottle	Glass or Polyethylene	Polyethylene
Impinger Storage Container	Alkali resistant polyethylene or glass	Polyethylene
Analytical Information		
Method 4 H_2O Determination by	Separate EPA Method 4 Sampling Train	Gravimetric
Filter Preparation Conditions	See Analytical Flowchart	See Analytical Flow Chart
Front-Half Rinse Preparation	See Analytical Flowchart	See Analytical Flow Chart
Back-Half Analysis	Ion Chromatography	Ion Chromatography
Additional Analysis	None	None

Other Test Method 29
Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape

Container 1
Front half (FH) particulate rinse (optional)
250 ml Glass

Probe nozzle, probe fitting, probe liner, FH filter holder and FH connecting glassware

Brush/rinse components 3X with acetone. Add to sample container

Seal, label and mark liquid level

Container 2
Filter catch for particulate determination (optional)

Remove with tweezers to original container. Brush any loose particulate or filter fibers to sample container

If necessary fold in half and place into container

Visual Inspection

Container 3
Impinger Catch
500 ml Polyethylene

Impingers 1, 2, 3 and connecting glassware

Record pH. Measure and *record volume* by weight

Quantitatively transfer liquid to sample container

Rinse impingers and connecting glassware 3X with 0.1N NaOH. Add to sample container

DO NOT RINSE THE BH FILTER HOLDER

Seal, label and mark liquid level

Container 4
Impinger Catch
500 ml Polyethylene

Impinger 4 and connecting glassware

Record pH. Measure and record volume by weight

Quantitatively transfer liquid to sample container

Rinse impingers and connecting glassware 3X with 0.1N NaOH. Add to sample container

Seal, label and mark liquid level

Container 5
Silica Gel

Weigh the spent silica gel to the nearest 0.5 grams

Recycle silica gel

Container 6
6N NaOH Blank

100 ml of 6N NaOH

Container 7
0.1N NaOH Blank

100 ml of 0.1N NaOH

Container 8
Acetone Blank

100 ml of acetone only if recovering Container 1

Field Train Blank

Sampling train was assembled, leak checked and recovered at sampling area, but no gaseous sample was collected

Field Spike Blank

2ml of Field Spike Standard into one impinger containing 100 ml NaOH. Follow standard impinger recovery procedures. Retain aliquot of Field Spike Standard for comparative analysis

Other Test Method 29
Analytical Flowchart

- Log each sample in shipment and verify against chain-of-custody sheet
- Note liquid levels in the sample containers and confirm on the chain-of-custody sheet condition

Containers 1 and 2 (Optional particulate analysis)

Follow analytical procedures outlined in EPA Method 5

Containers 3 and 4

Measure the sample volume. Sample dilution with 0.1N or 0.6N NaOH is recommended. The pH should not drop below 12 as a result of dilution

Analysis by ion chromatography for HCN

Each sample injected for analysis must have duplicate injection.

Perform a matrix spike at least once per set of sample or once per 10 samples analyzed. The amount of HCN recovered must be 20% of spiked value

If the response from cyanide in any sample is greater than the highest calibration standard, dilute with 0.1N or 0.6N NaOH and repeat analysis until response falls within calibration curve

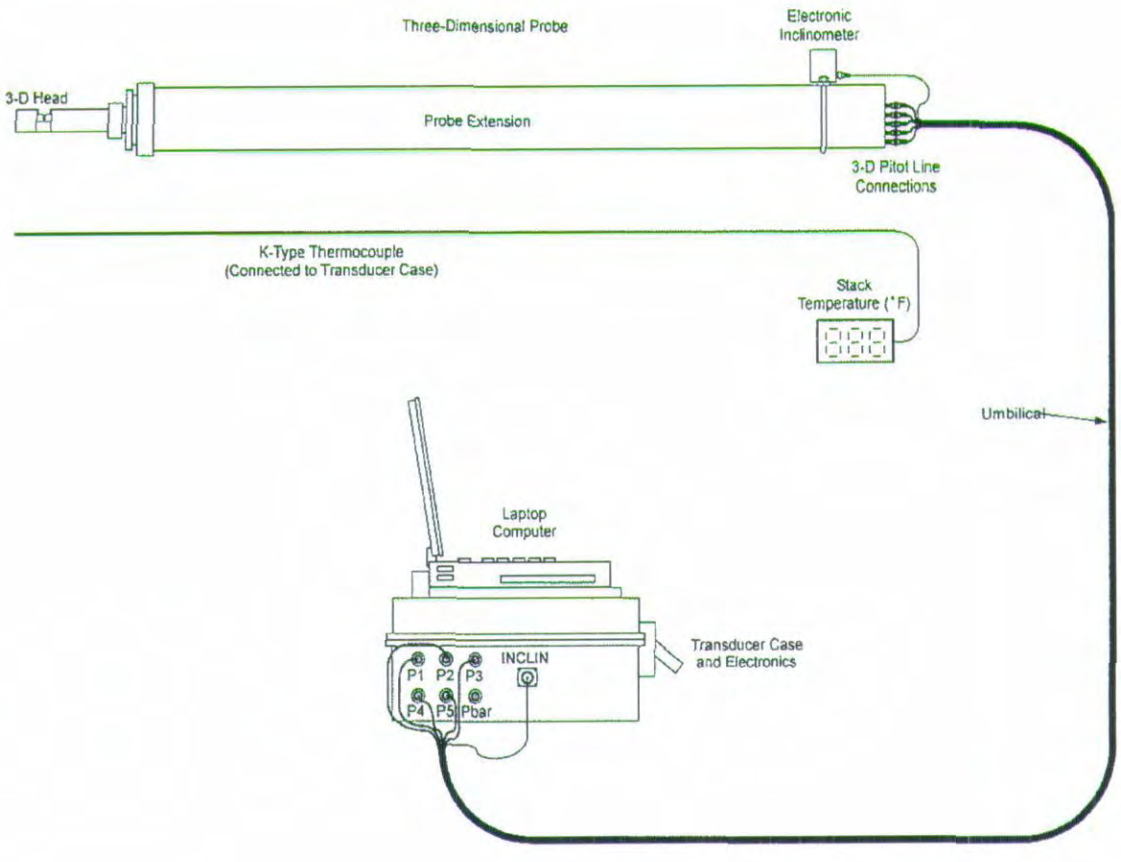
Container 5 Silica Gel

Weigh to nearest 0.5 g. This can be done in the field

Reagent Blanks

Analyze by ion chromatography for HCN

EPA Method 2F/2H
Sampling Train Configuration

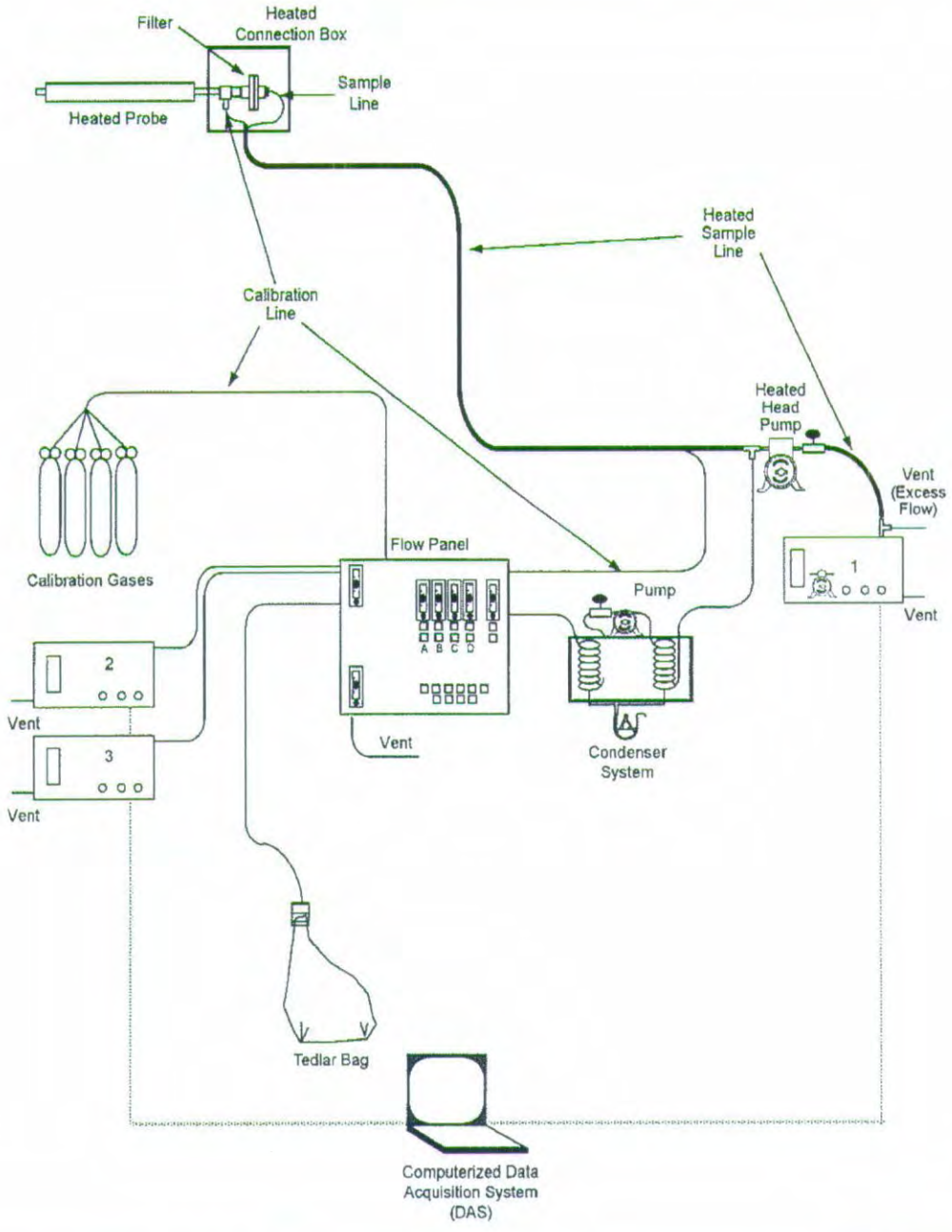


Specification Sheet for EPA Method 2F/2H

Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	None
Other Parameters to be Determined from Train	Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	Varied
No. of Sample Traverse Points	N/A	16/40
Sample Time per Point	N/A	Varied
Sampling Rate	N/A	N/A
Sampling Probe		
Nozzle Material	N/A	N/A
Nozzle Design	N/A	N/A
Probe Liner Material	N/A	N/A
Effective Probe Length	Sufficient to Traverse Points	8 feet
Probe Temperature Set-Point	N/A	N/A
Velocity Measuring Equipment		
Pitot Tube Design	3-D Probe	3-D Probe
Pitot Tube Coefficient	See Data Sheets	See Data Sheets
Pitot Tube Calibration by	Geometric or Wind Tunnel	Wind-Tunnel
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	ASC 3DDAS
Meter Accuracy	N/A	N/A
Meter Resolution	N/A	N/A
Meter Size	N/A	N/A
Meter Calibrated Against	N/A	N/A
Pump Type	N/A	N/A
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Digital Manometer
ΔH Differential Pressure Gauge	N/A	N/A
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	N/A	N/A
Filter Holder Material	N/A	N/A
Filter Support Material	N/A	N/A
Cyclone Material	N/A	N/A
Filter Heater Set-Point	N/A	N/A
Filter Material	N/A	N/A
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

EPA Methods 3A / 18 / 25A
Sampling Train Configuration



Number	Gas	Monitor	Range Used	Calibration Gas Concentrations
1	THC	JUM 3-300	0-100 ppmdv	0, 24.7, 45.4, 85.6
2	O2	Servomex 1420B	0-10%dv	0, 4.54, 9.05
3	CO2	Servomex 1415C	0-25%dv	0, 9.14, 19

Specification Sheet for EPA Method 25A

Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	Total Hydrocarbon (THC)
Other Parameters to be Determined from Train	O2 and CO2 (EPA Method 3A)

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	1
Sample Time per Point	N/A	60 minutes
Sampling Rate	Constant Rate	Constant Rate
Sampling Probe		
Nozzle Material	N/A	None
Nozzle Design	N/A	N/A
Probe Liner Material	Stainless Steel or Pyrex Glass	Stainless Steel
Effective Probe Length	Sufficient to Traverse Points	6 feet
Probe Temperature Set-Point	Prevent Condensation	248°F±25°F
Particulate Filter		
In-Stack Filter	Yes	No
In-Stack Filter Material	Non-reactive to gas	N/A
External Filter	Yes	Yes
External Filter Material	Borosilicate, Quartz Glass Wool or Fiber Mat	Borosilicate Glass Fiber Mat
External Filter Set-Point	Prevent Condensation	248°F±25°F
Sample Delivery System		
Heated Sample Line Material	Stainless Steel or Teflon	Teflon
Heated Sample Line Set-Point	Prevent Condensation	248°F±25°F
Heated Sample Line Connections	Probe Exit to Moisture Removal System	Probe to Moisture Removal System
Moisture Removal System	Refrigerator-type condenser or similar	Refrigerator-type condenser
Sample Pump Type	Leak-Free, minimal response time	Diaphragm
Sample Pump Material	Non-reactive to sample gases	Teflon
Sample Flow Control	Constant Rate	Constant Rate (±10%)
Non-Heated Sample Line Material	Stainless Steel or Teflon	Teflon
Non-Heated Sample Line Connections	Moisture Removal to Sample Gas Manifold	Moisture Removal to Sample Gas Manifold
Additional Filters	Optional	Yes
Additional Filter Type	N/A	Particulate Removal
Additional Filter Location	Optional	Entrance to Sample Manifold
Filter Material	Non-reactive to sample gases	Glass Fiber
Analyzer Description		
Oxygen (O_2)	EPA Method 3A (Paramagnetic)	EPA Method 3A (Paramagnetic)
Carbon Dioxide (CO_2)	EPA Method 3A (NDIR)	EPA Method 3A (NDIR)
Sulfur Dioxide (SO_2)	EPA Method 6C (UV, NDIR or Fluorescence)	N/A
Nitrogen Oxides (NO_x)	EPA Method 7E (Chemiluminescent)	N/A
Carbon Monoxide (CO)	EPA Method 10 (Gas Filter Correlation IR)	N/A
Total Hydrocarbon (THC)	EPA Method 25A (Flame Ionization)	EPA Method 25A (Flame Ionization Detection)
Hydrogen Chloride (HCl)	N/A	N/A
Ammonia (NH_3)	N/A	N/A

Specification Sheet for EPA Method 25A

	Standard Method Specification	Actual Specification Used
Instrument Span Range		
Oxygen (O_2)	≤ 1.33 x Expected Maximum	0-10%
Carbon Dioxide (CO_2)	≤ 1.33 x Expected Maximum	0-25%
Sulfur Dioxide (SO_2)	≤ 1.33 x Expected Maximum	N/A
Nitrogen Oxides (NO_x)	≤ 1.33 x Expected Maximum	N/A
Carbon Monoxide (CO)	1000 ppm maximum	N/A
Total Hydrocarbon (THC)	1.5 to 2.5 x Expected Maximum	0-100 ppm
Hydrogen Chloride (HCl)	N/A	N/A
Ammonia (NH_3)	N/A	N/A
Data Acquisition		
Data Recorder	Strip chart, Analog Computer or Digital Recorder	Digital Recorder
Recorder Resolution	0.5 Percent of Span	0.1 Percent of Span
Data Storage	Manually or Automatic	Automatic
Measurement Freq. ≤60 min. Sample Time	1-min. intervals or 30 measurements (less restrictive)	One reading per second
Recording Freq. ≤60 min. Sample Time	1-min. intervals or 30 measurements (less restrictive)	One Minute Average (60, 1 second readings)
Measurement Freq. >60 min. Sample Time	2-min. intervals or 96 measurements (less restrictive)	N/A
Recording Freq. >60 min. Sample Time	2-min. intervals or 96 measurements (less restrictive)	N/A
Calibration Gas Specifications		
Oxygen (O_2)	EPA Protocol 1	EPA Protocol 1
Carbon Dioxide (CO_2)	EPA Protocol 1	EPA Protocol 1
Sulfur Dioxide (SO_2)	EPA Protocol 1	N/A
Nitrogen Oxides (NO_x)	EPA Protocol 1	N/A
Carbon Monoxide (CO)	EPA Protocol 1	N/A
Total Hydrocarbon (THC)	EPA Protocol 1	EPA Protocol 1
Hydrogen Chloride (HCl)	N/A	N/A
Ammonia (NH_3)	N/A	N/A

Specification Sheet for EPA Method 18

Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	Methane (CH_4) and Ethane (C_2H_6)
Other Parameters to be Determined from Train	None

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	1
Sample Time per Point	N/A	60 minutes
Sampling Rate	Constant Rate (±10%)	Constant Rate (0.5 lpm±10%)
Sampling Probe		
Nozzle Material	N/A	None
Nozzle Design	N/A	N/A
Probe Liner Material	Teflon or Stainless Steel	None
Effective Probe Length	N/A	N/A
Probe Temperature Set-Point	Prevent condensation	None
Velocity Measuring Equipment		
Pitot Tube Design	None	None
Pitot Tube Coefficient	N/A	N/A
Pitot Tube Calibration by	N/A	N/A
Pitot Tube Attachment	N/A	N/A
Metering System Console		
Meter Type	Flow Meter, Critical Orifice or equivalent	Flow Meter
Meter Accuracy	±1%	±5%
Meter Resolution	N/A	0.01 liters
Meter Size	N/A	N/A
Meter Calibrated Against	Bubble Meter	N/A
Pump Type	Diaphragm or equivalent	Diaphragm
Temperature Measurements	Dial Thermometer or equivalent	N/A
Temperature Resolution	N/A	N/A
ΔP Differential Pressure Gauge	N/A	N/A
ΔH Differential Pressure Gauge	N/A	N/A
Barometer	Mercury, aneroid or other.	N/A
Filter Description		
Filter Location	N/A	None
Filter Holder Material	N/A	N/A
Filter Support Material	N/A	N/A
Cyclone Material	N/A	None
Filter Heater Set-Point	N/A	N/A
Filter Material	N/A	N/A
Sample Storage Components		
Description	Tedlar Bag or Stainless Steel Canister	Tedlar Bag
Location	After Pump and Flow Meter	After Pump and Flowmeter
Operating Temperature	N/A	Ambient

SAMPLE CALCULATIONS

B

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: PMK

Date: 05/14

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USEPA Method 5/202 (Particulate/CPM)
Sampling, Velocity and Moisture Sample Calculations

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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J

1. Volume of water collected (wscf)

$$V_{wstd} = (0.04706)(V_{lc})$$

Where:

V_{lc}	= total volume of liquid collected in impingers and silica gel (ml)	=	250.5	ml
0.04706	= ideal gas conversion factor (ft^3 water vapor/ml or gm)	=	0.04706	ft^3/ml
V_{wstd}	= volume of water vapor collected at standard conditions (ft^3)	=	11.79	ft^3

2. Volume of gas metered, standard conditions (dscf)

$$V_{mstd} = \frac{(17.64)(V_m)\left(P_{bar} + \frac{\Delta H}{13.6}\right)(Y_d)}{(460 + T_m)}$$

Where:

P_{bar}	= barometric pressure (in. Hg)	=	29.76	in. Hg
T_m	= average dry gas meter temperature (°F)	=	71.71	°F
V_m	= volume of gas sample through the dry gas meter at meter conditions (dcf)	=	37.42	dcf
Y_d	= gas meter correction factor (dimensionless)	=	0.9931	
ΔH	= average pressure drop across meter box orifice (in. H_2O)	=	1.36	in. H_2O
17.64	= standard temperature to pressure ratio (°R/in. Hg)	=	17.64	°R/in. Hg
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in.H_2O/in. Hg
460	= °F to °R conversion constant	=	460	
V_{mstd}	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	36.812	dscf

3. Sample gas pressure (in. Hg)

$$P_s = P_{bar} + \left(\frac{P_g}{13.6}\right)$$

Where:

P_{bar}	= barometric pressure (in. Hg)	=	29.76	in. Hg
P_g	= sample gas static pressure (in. H_2O)	=	0.20	in. H_2O
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in. H_2O/in. Hg
P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg

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4. Actual water vapor pressure at sample gas temperature less than 212°F (in. Hg)

$$P_v = \frac{e^{\left(18.3036 - \frac{3816.44}{\frac{5}{9}(T_s - 32) + 273.15 - 46.13}\right)}}{25.4}$$

Where:

T_s	= average sample gas temperature (°F)	=	144.17	°F
18.3036	= Antoine coefficient	=	18.3036	°K
3816.44	= Antoine coefficient	=	3816.44	°K
273.15	= temperature conversion factor	=	273.15	°K
46.13	= Antoine coefficient	=	46.13	°K
25.4	= conversion factor	=	25.4	mm Hg/in. Hg
5/9	= Fahrenheit to Celsius conversion factor	=	5/9	°C/°F
32	= temperature conversion (°F)	=	32	°F
P_v	= vapor pressure, actual (in. Hg)	=	6.54	in. Hg

5. Water vapor pressure at gas temperature greater than 212°F (in. Hg)

$$P_v = P_s$$

Where:

P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg
P_v	= water vapor pressure, actual (in. Hg)	=	Previously Defined	in. Hg

6. Moisture measured in sample (% by volume)

$$B_{wo} = \frac{V_{wstd}}{(V_{mstd} + V_{wstd})}$$

Where:

V_{mstd}	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	36.812	dscf
V_{wstd}	= volume of water collected at standard conditions (scf)	=	11.79	scf
B_{wo}	= proportion of water measured in the gas stream by volume	=	0.2426	
		=	24.26	%

7. Saturated moisture content (% by volume)

$$B_{ws} = \frac{P_v}{P_s}$$

Where:

P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg
P_v	= water vapor pressure, actual (in. Hg)	=	6.54	in. Hg
B_{ws}	= proportion of water vapor in the gas stream by volume at saturated conditions		0.2198	
		=	21.98	%

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SS ISCKINETIC Version 2006-13a

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8. Actual water vapor in gas (% by volume)

$$B_w = MINIMUM \left[B_{wo}, B_{ws} \right]$$

Where:

B_{ws}	= proportion of water vapor in the gas stream by volume at saturated conditions	=	0.2198	
B_{wo}	= proportion of water measured in the gas stream by volume	=	0.2426	
B_w	= actual water vapor in gas	=	0.2198	
		=	21.98	%

9. Nitrogen (plus carbon monoxide) in gas stream (% by volume, dry)

$$N_2 + CO = 100 - CO_2 - O_2$$

Where:

CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	17.5	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.3	%
100	= conversion factor (%)	=	100	%
N_2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=	80.25	%

10. Molecular weight of dry gas stream (lb/lb·mole)

$$M_d = (M_{CO_2})\frac{(CO_2)}{(100)} + (M_{O_2})\frac{(O_2)}{(100)} + (M_{N_2+CO})\frac{(N_2+CO)}{(100)}$$

Where:

M_{CO2}	= molecular weight of carbon dioxide (lb/lb·mole)	=	44.00	lb/lb·mole
M_{O2}	= molecular weight of oxygen (lb/lb·mole)	=	32.00	lb/lb·mole
M_{N2+CO}	= molecular weight of nitrogen and carbon monoxide (lb/lb·mole)	=	28.00	lb/lb·mole
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	17.5	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.3	%
N_2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=	80.3	%
100	= conversion factor (%)	=	100	%
M_d	= dry molecular weight of sample gas (lb/lb·mole)	=	30.88	lb/lb·mole

11. Molecular weight of sample gas (lb/lb·mole)

$$M_s = (M_d)(1 - B_w) + (M_{H_2O})(B_w)$$

Where:

B_w	= proportion of water vapor in the gas stream by volume	=	0.2198	
M_d	= dry molecular weight of sample gas (lb/lb·mole)	=	30.88	lb/lb·mole
M_{H2O}	= molecular weight of water (lb/lb·mole)	=	18.00	lb/lb·mole
M_s	= molecular weight of sample gas, wet basis (lb/lb·mole)	=	28.05	lb/lb·mole

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12. Velocity of sample gas (ft/sec)

$$V_s = (K_p)(C_p)\sqrt{\Delta P}\left(\sqrt{\frac{(\overline{T_s}+460)}{(M_s)(P_s)}}\right)$$

Where:

K_p	= velocity pressure constant	=	85.49	
C_p	= pitot tube coefficient	=	0.83	
M_s	= wet molecular weight of sample gas, wet basis (lb/lb·mole)	=	28.05	lb/lb·mole
P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg
T_s	= average sample gas temperature (°F)	=	144.17	°F
$\sqrt{\Delta P}$	= average square roots of velocity heads of sample gas (in. H_2O)	=	0.607	$\sqrt{}$in. H_2O
460	= °F to °R conversion constant	=	460	
V_s	= sample gas velocity (ft/sec)	=	36.70	ft/sec

13. Volumetric flow rate of sample gas at actual gas conditions (acfm)

$$Q_a = (60)(A_s)(V_s)$$

Where:

A_s	= cross sectional area of sampling location (ft^2)	=	132.73	ft^2
V_s	= sample gas velocity (ft/sec)	=	36.70	ft/sec
60	conversion factor (sec/min)	=	60	sec/min
Q_a	= volumetric flow rate at actual conditions (acfm)	=	292,239	acfm

14. Total flow of sample gas (scfm)

$$Q_s = (Q_a)\left(\frac{P_s}{29.92}\right)\left(\frac{68+460}{T_s+460}\right)$$

Where:

Q_a	= volumetric flow rate at actual conditions (acfm)	=	292,239	acfm
P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg
29.92	= standard pressure (in. Hg)	=	29.92	in. Hg
T_s	= average sample gas temperature (°F)	=	144.2	°F
68	= standard temperature (°F)	=	68	°F
460	= °F to °R conversion constant	=	460	
Q_s	= volumetric flow rate at standard conditions, wet basis (scfm)	=	254,157	scfm

15. Dry flow of sample gas (dscfm)

$$Q_{std} = (Q_s)(1 - B_w)$$

Where:

B_w	= proportion of water vapor in the gas stream by volume	=	0.2198	
Q_s	= volumetric flow rate at standard conditions, wet basis (scfm)	=	254,157	scfm
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	198,302	dscfm

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16. Dry flow of sample gas corrected to 7%O_2 (dscfm)

$$Q_{std\,7} = (Q_{std})\left(\frac{20.9 - O_2}{20.9 - 7}\right)$$

Where:

Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	198,302	dscfm
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.3	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
7	= oxygen content of corrected gas (%)	=	7.0	%
Q_{std7}	= volumetric flow rate at STP and 7%O_2, dry basis (dscfm)	=	265,354	dscfm

17. Hourly time basis conversion of volumetric flow rate (Q_{std} example)

$$Q_{std-hr} = (Q_{std-min})(60)$$

Where

$Q_{std-min}$	= volumetric flow rate, english units (ft^3/min)	=	198,302	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
Q_{std-hr}	= volumetric flow rate, hourly basis (dscf/hr)	=	11,898,138	dscf/hr

18. Metric Conversion of Gas Volumes (Q_{std} example)

$$Q_{std-metric} = (Q_{std-english})\left(\frac{60}{35.31}\right)$$

Where:

$Q_{std-english}$	= volumetric flow rate, english units (ft^3/min)	=	198,302	dscfm
35.31	= conversion factor (ft^3/m^3)	=	35.31	ft^3/m^3
60	= conversion factor (min/hr)	=	60	min/hr
$Q_{std-metric}$	= volumetric flow rate, metric units (m^3/hr)	=	336,962	dry std m^3/hr

19. Standard to Normal Conversion of Gas Volumes (Q_{std} example)

$$Q_{Normal} = (Q_{std-metric})\left(\frac{32 + 460}{68 + 460}\right)$$

Where:

$Q_{std-metric}$	= volumetric flow rate, metric units (dry std m^3/hr)	=	336,962	dry std m^3/hr
32	= normal temperature (°F)	=	32	°F
68	standard temperature (°F)	=	68	°F
460	= standard temperature in Rankine (68°F)	=	460	
Q_{Normal}	= volumetric flow rate, metric units (dry Nm^3/hr)	=	313,988	dry Nm^3/hr

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20. Percent isokinetic (%)

$$I = \frac{(0.09450)(\overline{T_s} + 460)(V_{mstd})}{(P_s)(V_s)(\frac{(D_n)^2(\pi)}{(144)(4)})(\Theta)(1 - B_w)}$$

Where:

D_n	= diameter of nozzle (in)	=	0.276	in.
B_w	= proportion of water vapor in the gas stream by volume	=	0.2198	
P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg
T_s	= average sample gas temperature (°F)	=	144.2	°F
V_{mstd}	= volume of gas sample through the dry gas meter at standard conditions (dscf)	=	36.812	dscf
V_s	= sample gas velocity (ft/sec)	=	36.70	ft/sec
θ	= total sampling time (min)	=	60	min
0.0945	= conversion constant	=	0.0945	
460	= °F to °R conversion constant	=	460	
I	= percent of isokinetic sampling (%)	=	98.90	%

21. Alternative Method 5 Post-Test Meter Calibration Factor

$$Y_{qa} = \frac{\Theta}{V_m}\sqrt{\frac{(0.0319)(T_m + 460)(28.96)}{(\Delta H_@)(P_{bar} + \frac{\Delta H}{13.6})(M_d)}}(\sqrt{\Delta H})_{avg}$$

Where:

θ	= total sampling time (min)	=	60	min
V_m	= volume of gas sample through the dry gas meter at meter conditions (dcf)	=	37.42	dcf
T_m	= average dry gas meter temperature (°F)	=	71.71	°F
$\Delta H_@$	= dry gas meter orifice coefficient	=	1.7476	
P_{bar}	= barometric pressure (in. Hg)	=	29.76	in. Hg
ΔH	= average pressure drop across meter box orifice (in. H_2O)	=	1.363	in. H_2O
M_d	= dry molecular weight of sample gas (lb/lb·mole)	=	30.88	lb/lb·mole
$\sqrt{\Delta H_{avg}}$	= average of square root of pressure drop across meter orifice	=	1.164	√in. H_2O
0.0319	= conversion constant	=	0.0319	
28.96	= molecular weight of ambient air (lb/lb-mole)	=	28.96	lb/lb-mole
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in.H_2O/in. Hg
460	= °F to °R conversion constant	=	460	
Y_{qa}	= alternative Method 5 post-test meter calibration factor	=	1.0308	

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USEPA Method 5/202 (FPM/CPM)
Sample Laboratory Analysis Calculations for FPM

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Residue mass of filter used in calculation

$$m_{fi\text{-}calc} = m_{fi} \quad \text{if } m_{fi} \geq MDL_f$$
$$m_{fi\text{-}calc} = (MDL_f)(F_r) \quad \text{if } m_{fi} < MDL_f$$

Where:

m_{f1}	= reported mass of filter "1" from gravimetric analysis (g)	=	0.00576	g
MDL_f	= reported minimum gravimetric detection limit for filter fraction (g)	=	0.00020	g
F_r	= fraction of MDL applied to non-detectable run sample (g)	=	0.00	
$m_{f1\text{-}calc}$	= residue mass of filter "1" used in calculation (g)	=	0.00576	g

2. Total filter residue (g)

$$m_{filter} = \sum_{i=1}^{n} m_{fi\text{-}calc}$$

Where:

$m_{f1\text{-}calc}$	= residue mass of filter "1" used in calculation (g)	=	0.00576	g
m_{filter}	= total particulate collected on filters (g)	=	0.00576	g

3. Aliquot residue mass of blank sample used in calculation (g)

$$r_{ai\text{-}blank\text{-}calc} = r_{ai\text{-}blank} \quad \text{if } r_{ai\text{-}blank} \geq MDL_s$$
$$r_{ai\text{-}blank\text{-}calc} = (MDL_s)(F_b) \quad \text{if } r_{ai\text{-}blank} < MDL_s$$

Where:

			Acetone	
$r_{ai\text{-}blank}$	= aliquot residue mass of blank sample for solvent "i" (g)	=	ND	g
MDL_s	= reported minimum gravimetric detection limit for solvent rinse (g)	=	0.00025	g
F_b	= fraction of MDL applied to non-detectable blank sample (g)	=	0.00	
$r_{ai\text{-}blank\text{-}calc}$	= aliquot residue mass of blank sample for solvent "i" used in calculation (g)	=	0.00000	g

4. Aliquot residue mass of run sample used in calculation (g)

$$r_{ai\text{-}calc} = r_{ai} \quad \text{if } r_{ai} \geq MDL_s$$
$$r_{ai\text{-}calc} = (MDL_s)(F_r) \quad \text{if } r_{ai} < MDL_s$$

Where:

			Acetone	
r_{ai}	= aliquot residue mass of run sample for solvent "i" (g)	=	0.00312	g
MDL_s	= reported minimum gravimetric detection limit for solvent rinse (g)	=	0.00025	g
F_r	= fraction of MDL applied to non-detectable run sample (g)	=	1.00	
$r_{ai\text{-}calc}$	= aliquot residue mass of run sample for solvent "i" used in calculation (g)	=	0.00312	g

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5. Residue mass of run sample (g)

$$r_{si} = \left(r_{ai-calc}\right)\left(\frac{v_{si}}{v_{ai}}\right)$$

Where:			Acetone	
$r_{ai-calc}$	= aliquot residue mass of run sample for solvent "i" used in calculation (g)	=	0.00312	g
v_{si}	= liquid volume of run sample for solvent rinse "i" (mL)	=	112	mL
v_{ai}	= aliquot volume use for solvent rinse "i" (mL) used in gravimetric analysis (mL)	=	112	mL
r_{si}	= residue mass of run sample for solvent rinse "i" (g)	=	0.00312	g

6. Maximum allowable blank correction for solvent rinse (g)

$$m_{bi} = MINIMUM\left[\left(\frac{\left(r_{ai-blank-calc}\right)\left(v_{si}\right)}{v_{ai-blank}}\right) \; or \; \left(0.00001\right)\left(\rho_i\right)\left(v_{si}\right) \; or \; \left(r_{si}\right)\right]$$

Where:			Acetone	
$r_{ai-blank-calc}$	= blank aliquot residue mass for solvent "i" used in calculation (g)	=	0.00000	g
v_{si}	= liquid volume of run sample for solvent rinse "i" (mL)	=	112.0	mL
$v_{ai-blank}$	= liquid volume of blank sample for solvent rinse "i" (mL)	=	206.0	mL
0.00001	= EPA M-5 fraction of total rinse that can be subtracted (g)	=	0.00001	
ρ_i	= density of solvent rinse "i" (g/mL)	=	0.7845	g/ml
r_{si}	= residue mass of run sample for solvent rinse "i" (g)	=	0.00312	g
m_{bi}	= maximum allowable blank correction for solvent rinse "i" (g)	=	0.00000	g

The first part of the expression is used for solvent rinse 1; the blank is the concentration of the blank, times the size of the sample

7. Net residue mass of run sample (g)

$$m_i = \left(r_{si} - m_{bi}\right)$$

Where:			Acetone	
r_{si}	= residue mass of run sample for solvent rinse "i" (g)	=	0.00312	g
m_{bi}	= maximum allowable blank correction for solvent rinse "i" (g)	=	0.00000	g
m_i	= net residue mass of run sample for solvent rinse "i" (g)	=	0.00312	g

8. Total solvent residue - (g)

$$m_s = \sum_{i=1}^{n} m_i$$

Where:				
m_1	= net residue mass of solvent rinse "1" (g)	=	0.00312	g
m_2	= net residue mass of solvent rinse "2" (g)	=	N/A	g
m_3	= net residue mass of solvent rinse "3" (g)	=	N/A	g
m_s	= total solvent residue (g)	=	0.00312	g

9. Total gravimetric result (g)

$$m_T = m_{filter} + m_s$$

Where:				
m_{filter}	= total particulate collected on filters (g)	=	0.00576	g
m_s	= total solvent residue (g)	=	0.00312	g
m_T	= total gravimetric result (g)	=	0.00888	g

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10. Total gravimetric detection limit (g)

$$m_D = (MDL_f)(n_f) + (MDL_s)(n_s)$$

Where:

MDL_f	= reported minimum gravimetric detection limit for filter fraction (g)	=	0.00020	g
n_f	= number of filters in analysis	=	1	
MDL_s	= reported minimum gravimetric detection limit for solvent rinse (g)	=	0.00025	g
n_s	= number of solvent rinses in analysis	=	1	
m_D	= total gravimetric detection limit (g)	=	0.00045	g

11. Total filterable particulate matter (g)

$$m_n = MAXIMUM[m_T \text{ or } m_D]$$

Where:

m_T	= total gravimetric result (g)	=	0.00888	g
m_D	= total gravimetric detection limit (g)	=	0.00045	g
m_n	= total filterable particulate matter (g)	=	0.00888	g

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USEPA Method 5/202 (FPM/CPM)
Sample Emission Calculations for FPM

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Filterable particulate matter concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(2.205\times10^{-3}\right)$$

Where:

m_n	= total filterable particulate matter (g)	=	0.00888	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
C_{sd}	= filterable particulate matter concentration (lb/dscf)	=	5.3190E-07	lb/dscf

2. Filterable particulate matter concentration (gr/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(15.43\right)$$

Where:

m_n	= total filterable particulate matter (g)	=	0.00888	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
15.43	= conversion factor (gr/g)	=	0.00	gr/g
C_{sd}	= filterable particulate matter concentration (gr/dscf)	=	0.0037	gr/dscf

3. Filterable particulate matter concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(1000\right)\left(35.31\right)$$

Where:

m_n	= total filterable particulate matter (g)	=	0.00888	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
1000	= conversion factor (mg/g)	=	35	mg/g
35.31	= conversion factor (dscf/dscm)	=	460.00	dscf/dscm
C_{sd}	= filterable particulate matter concentration (mg/dscm)	=	8.5176	mg/dscm

4. Filterable particulate matter concentration (mg/Nm3 dry)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(1000\right)\left(35.31\right)\left(\frac{68+460}{32+460}\right)$$

Where:

m_n	= total filterable particulate matter (g)	=	0.00888	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
1000	= conversion factor (mg/g)	=	35	mg/g
35.31	= conversion factor (dscf/dscm)	=	460.00	dscf/dscm
68	= standard temperature (°F)	=	12	°F
32	= normal temperature (°F)	=	68	°F
460	= °F to °R conversion constant	=	18	
C_{sd}	= filterable particulate matter concentration (mg/Nm3 dry)	=	9.1409	mg/Nm^3 dry

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5. Filterable particulate matter concentration corrected to x% O2 (gr/dscf example)

$$C_{sdx} = C_{sd}\left(\frac{20.9 - x}{20.9 - O_2}\right)$$

Where:

C_{sd}	= filterable particulate matter concentration (gr/dscf)	=	0.0037	gr/dscf
x	= oxygen content of corrected gas (%)	=	2000.0	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.3	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
C_{sdx}	= filterable particulate matter concentration corrected to x%O2 (gr/dscf)	=	0.0028	gr/dscf @ x%O_2

6. Filterable particulate matter concentration corrected to y% CO2 (gr/dscf example)

$$C_{sdy} = C_{sd}\left(\frac{y}{CO_2}\right)$$

Where:

C_{sd}	= filterable particulate matter concentration (gr/dscf)	=	0.0037	gr/dscf
y	= carbon dioxide content of corrected gas (%)	=	7.0	%
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	17.5	%
C_{sdy}	= filterable particulate matter concentration corrected to y%CO2 (gr/dscf)	=	0.0026	gr/dscf @ y%CO_2

7. Filterable particulate matter concentration at actual gas conditions (gr/acf example)

$$C_a = C_{sd}\left(\frac{Q_{std}}{Q_a}\right)$$

Where:

C_{sd}	= filterable particulate matter concentration (gr/dscf)	=	0.0037	gr/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
Q_a	= volumetric flow rate at actual conditions (acfm)	=	266,323	acfm
C_a	= filterable particulate matter concentration at actual gas conditions (gr/acf)	=	0.0025	gr/acf

8. Filterable particulate matter rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_n}{V_{mstd}}\right)(2.205\times10^{-3})(Q_{std})(60)$$

Where:

m_n	= total filterable particulate matter (g)	=	0.00888	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= filterable particulate matter rate (lb/hr)	=	5.7467	lb/hr

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9. Filterable particulate matter rate (kg/hr)

$$E_{kg/hr} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{(Q_{std})(60)}{1000}\right)$$

Where:

m_n	= total filterable particulate matter (g)	=	0.00888	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
1000	= conversion factor (g/kg)	=	35	g/kg
$E_{kg/hr}$	= filterable particulate matter rate (kg/hr)	=	2.6062	kg/hr

10. Filterable particulate matter rate (Ton/yr)

$$E_{T/yr} = \left(\frac{m_n}{V_{mstd}}\right)(2.205\times10^{-3})(Q_{std})(60)\left(\frac{Cap}{2000}\right)$$

Where:

m_n	= total filterable particulate matter (g)	=	0.00888	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
Cap	= capacity factor for process (hours operated/year)	=	8,760	hours/yr
2000	= conversion factor (lb/Ton)	=	0	lb/Ton
$E_{T/yr}$	= filterable particulate matter rate (Ton/yr)	=	25.1704	Ton/yr

11. Filterable particulate matter rate - Production-based (lb/Mlb Coke)

$$E_{Rp} = \left(\frac{m_n}{V_{mstd}}\right)(2.205\times10^{-3})\left(\frac{(Q_{std})(60)}{R_p}\right)$$

Where:

m_n	= total filterable particulate matter (g)	=	0.00888	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
R_p	= production rate (Mlb Coke/hr)	=	70	Mlb Coke/hr
E_{Rp}	= filterable particulate matter rate - production-based (lb/Mlb Coke)	=	0.08247	lb/Mlb Coke

12. Filterable particulate matter rate - Production-based (kg/Mlb Coke)

$$E_{Rp} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{(Q_{std})(60)}{(1000)(R_p)}\right)$$

Where:

m_n	= total filterable particulate matter (g)	=	0.00888	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
1000	= conversion factor (g/kg)	=	1000	g/kg
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
R_p	= production rate (Mlb Coke/hr)	=	70	Mlb Coke/hr
E_{Rp}	= filterable particulate matter rate - production-based (kg/Mlb Coke)	=	0.03740	kg/Mlb Coke

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USEPA Method 5/202 (FPM/CPM)
Sample Laboratory Analysis Calculations for CPM

Sample data taken from Run 1

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1. Aliquot residue mass of inorganic blank sample used in calculation (g)

$$r_{ai-blank-calc} = r_{ai-blank} \quad \text{if } r_{ai-blank} \geq MDL_i$$
$$r_{ai-blank-calc} = (MDL_i)(F_b) \quad \text{if } r_{ai-blank} < MDL_i$$

Where:

$r_{ai-blank}$	= aliquot residue mass of inorganic blank sample (g)	=	0.00133	g
MDL_i	= reported minimum gravimetric detection limit for inorganic fraction (g)	=	0.00023	g
F_b	= fraction of MDL applied to non-detectable blank samples (g)	=	0.00	
$r_{ai-blank-calc}$	= aliquot residue mass of inorganic blank sample used in calculation (g)	=	0.00133	g

2. Aliquot residue mass of inorganic run sample used in calculation (g)

$$r_{ai-calc} = r_{ai} \quad \text{if } r_{ai} \geq MDL_i$$
$$r_{ai-calc} = (MDL_i)(F_r) \quad \text{if } r_{ai} < MDL_i$$

Where:

r_{ai}	= aliquot residue mass of inorganic run sample (g)	=	0.00882	g
MDL_i	= reported minimum gravimetric detection limit for inorganic fraction (g)	=	0.00023	g
F_r	= fraction of MDL applied to non-detectable run samples (g)	=	1.00	
$r_{ai-calc}$	= aliquot residue mass of inorganic run sample used in calculation (g)	=	0.00882	g

3. Condensed moisture volume in inorganic sample fraction (mL)

$$v_{ci} = v_{impl} + v_{imp2} + v_{jr}$$

Where:

v_{imp1}	= volume of moisture condensed in Impinger 1 during test run (mL)	=	176.7	mL
v_{imp2}	= volume of moisture condensed in Impinger 2 during test run (mL)	=	40.7	mL
v_{jr}	= volume of jumper rinse (mL)	=	0.0	mL
v_{ci}	= condensed moisture volume in inorganic sample fraction (mL)	=	217.4	mL

4. Residue mass of inorganic run sample (g)

$$r_i = (r_{ai-calc})\left(\frac{v_{si}}{v_{ai}}\right)$$

Where:

$r_{ai-calc}$	= aliquot residue mass of inorganic run sample used in calculation (g)	=	0.00882	g
v_{si}	= liquid volume of inorganic run sample (mL)	=	664	mL
v_{ai}	= aliquot volume of inorganic run sample used in gravimetric analysis (mL)	=	664	mL
r_i	= residue mass of inorganic run sample (g)	=	0.00882	g

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5. Mass of NH_3 added to form ammonium sulfate during titration of inorganic fraction (g)

$$m_c = (17.03)(N)(v_t)(0.001) \quad \text{if } pH < pH_{limit}$$
$$m_c = 0 \quad \text{if } pH \geq pH_{limit}$$

Where:

17.03	= conversion constant for NH_3 (equation 12.2.1 of EPA M-202)	=	17.03	
N	= normality of titrant (meq/mL)	=	0.0556	mg/L
v_t	= volume of titrant added (mL)	=	0.30	mL
0.001	= conversion factor, (g/mg)	=	0.001	g/mg
pH	= pH of the inorganic fraction	=	3.45	
pH_{limit}	= pH limit for ammonium titration	=	4.5	
m_c	= mass of NH_3 added to form ammonium sulfate during titration of inorganic fraction (g)	=	0.00028	g

For Run 1, this correction was made due to a sample pH less than 4.5 and the addition of NH4OH to the sample.

6. Aliquot residue mass of organic blank sample used in calculation (g)

$$r_{ao-blank-calc} = r_{ao-blank} \quad \text{if } r_{ao-blank} \geq MDL_o$$
$$r_{ao-blank-calc} = (MDL_o)(F_b) \quad \text{if } r_{ao-blank} < MDL_o$$

Where:

$r_{ao-blank}$	= aliquot residue mass of organic blank sample (g)	=	0.00132	g
MDL_o	= reported minimum gravimetric detection limit for organic fraction (g)	=	0.00025	g
F_b	= fraction of MDL applied to non-detectable blank samples (g)	=	0.00	
$r_{ao-blank-calc}$	= aliquot residue mass of organic blank sample used in calculation (g)	=	0.00132	g

7. Aliquot residue mass of organic run sample used in calculation (g)

$$r_{ao-calc} = r_{ao} \quad \text{if } r_{ao} \geq MDL_o$$
$$r_{ao-calc} = (MDL_o)(F_r) \quad \text{if } r_{ao} < MDL_o$$

Where:

r_{ao}	= aliquot residue mass of organic run sample (g)	=	0.00210	g
MDL_o	= reported minimum gravimetric detection limit for organic fraction (g)	=	0.00025	g
F_r	= fraction of MDL applied to non-detectable run samples (g)	=	1.00	
$r_{ao-calc}$	= organic sample aliquot residue mass used in calculation (g)	=	0.00210	g

8. Residue mass of organic sample (g)

$$r_o = (r_{ao-calc})\left(\frac{v_{so}}{v_{ao}}\right)$$

Where:

$r_{ao-calc}$	= aliquot residue mass of organic run sample used in calculation (g)	=	0.00210	g
v_{so}	= liquid volume of organic run sample (mL)	=	547	mL
v_{ao}	= aliquot volume of organic run sample used in gravimetric analysis (mL)	=	547	mL
r_o	= residue mass of organic sample (g)	=	0.00210	g

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9. Maximum allowable inorganic blank correction (g)

$$m_{bi} = MINIMUM\left[\left(\frac{\left(r_{ai-blank-calc} - m_{c-blank}\right)\left(v_{si} - v_{ci}\right)}{v_{ai-blank}}\right) \quad or \quad (0.002)\left(\frac{\left(r_{ai-blank-calc} - m_{c-blank}\right)}{\left(r_{ai-blank-calc} - m_{c-blank}\right) + r_{ao-blank-calc}}\right) \quad or \quad \left(r_i - m_c\right)\right]$$

if $\left(r_{ai-blank-calc} - m_{c-blank}\right) + r_{ao-blank-calc} > 0$

$m_{bi} = 0$ if $\left(r_{ai-blank-calc} - m_{c-blank}\right) + r_{ao-blank-calc} \le 0$

Where:

$r_{ai\text{-}blank\text{-}calc}$	= aliquot residue mass of inorganic blank sample used in calculation (g)	=	0.00133	g
$m_{c\text{-}blank}$	= mass of NH_3 added to form ammonium sulfate during titration of inorganic blank (g)	=	0.00682	g
v_{si}	= liquid volume of inorganic run sample (mL)	=	664	mL
v_{ci}	= condensed moisture volume in inorganic sample fraction (mL)	=	217.4	mL
$v_{ai\text{-}blank}$	= aliquot volume of inorganic blank sample used in gravimetric analysis (mL)	=	334	mL
0.002	= maximum total blank correction (equation 12.2.2 of EPA M-202) (g)	=	0.002	g
$r_{ao\text{-}blank\text{-}calc}$	= aliquot residue mass of organic blank sample used in calculation (g)	=	0.00132	g
r_i	= residue mass of inorganic run sample (g)	=	0.00882	g
m_c	= mass of NH_3 added to form ammonium sulfate during titration of inorganic fraction (g)	=	0.00028	g
m_{bi}	= maximum allowable inorganic blank correction (g)	=	-0.00734	g

The first part of the first expression is used; the blank is the inorganic blank concentration multiplied by the volume of reagent used to recover the sample run (sample volume minus condensed moisture volume)

10. Net residue mass of inorganic run sample after NH_3 and blank correction (g)

$$m_{ri} = r_i - m_c - m_{bi}$$

Where:

r_i	= residue mass of inorganic run sample (g)	=	0.00882	g
m_c	= mass of NH_3 added to form ammonium sulfate during titration of inorganic fraction (g)	=	0.00028	g
m_{bi}	= maximum allowable inorganic blank correction (g)	=	-0.00734	g
m_{ri}	= net residue mass of inorganic run sample after NH_3 and blank correction (g)	=	0.01587	g

11. Total inorganic condensable particulate matter (g)

$$m_{CPMi} = MAXIMUM\left[m_{ri} \quad or \quad MDL_i\right]$$

Where:

m_{ri}	= net inorganic residue mass of sample after NH_3 and blank correction (g)	=	0.01587	g
MDL_i	= reported minimum gravimetric detection limit for inorganic fraction (g)	=	0.00023	g
m_{CPMi}	= total inorganic condensable particulate matter (g)	=	0.01587	g

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12. Maximum allowable organic blank correction (g)

$$m_{bo} = MINIMUM\left[\left(\frac{(r_{ao-blank-calc})(v_{so})}{v_{ao-blank}}\right) \text{ or } (0.002)\left(\frac{r_{ao-blank-calc}}{(r_{ai-blank-calc} - m_{c-blank}) + r_{ao-blank-calc}}\right) \text{ or } (r_o)\right] \quad \text{if } (r_{ai-blank-calc} - m_{c-blank}) + r_{ao-blank-calc} > 0$$

$$m_{bo} = 0 \quad \text{if } (r_{ai-blank-calc} - m_{c-blank}) + r_{ao-blank-calc} \le 0$$

Where:

$r_{ao-blank-calc}$	= aliquot residue mass of organic blank sample used in calculation (g)	=	0.00132	g
v_{so}	= liquid volume of organic run sample (mL)	=	547	mL
$v_{ao-blank}$	= aliquot volume of organic blank sample used in gravimetric analysis (mL)	=	332	mL
0.002	= maximum total blank correction (equation 12.2.2 of EPA M-202) (g)	=	0.002	g
$r_{ai-blank-calc}$	= aliquot residue mass of inorganic blank sample used in calculation (g)	=	0.00133	g
$m_{c-blank}$	= mass of NH_3 added to form ammonium sulfate during titration of inorganic blank (g)	=	0.00682	g
r_o	= residue mass of organic run sample (g)	=	0.00210	g
m_{bo}	= maximum allowable organic blank correction (g)	=	-0.00063	g

The second part of the expression is used; the blank exceeds the maximum organic blank correction

13. Net organic residue mass of sample after blank correction (g)

$$m_{ro} = r_o - m_{bo}$$

Where:

r_o	= residue mass of organic run sample (g)	=	0.00210	g
m_{bo}	= maximum allowable organic blank correction (g)	=	-0.00063	g
m_{ro}	= net organic residue mass of sample after blank correction (g)	=	0.00273	g

14. Total organic condensable particulate matter (g)

$$m_{CPMo} = MAXIMUM[m_{ro} \text{ or } MDL_o]$$

Where:

m_{ro}	= net organic residue mass of sample after blank correction (g)	=	0.00273	g
MDL_o	= reported minimum gravimetric detection limit for organic fraction (g)	=	0.00025	g
m_{CPMo}	= total organic condensable particulate matter (g)	=	0.00273	g

15. Total gravimetric result (g)

$$m_T = m_{CPMi} + m_{CPMo}$$

Where:

m_{CPMi}	= total inorganic condensable particulate matter (g)	=	0.01587	g
m_{CPMo}	= total organic condensable particulate matter (g)	=	0.00273	g
m_T	= total gravimetric result (g)	=	0.01861	g

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16. Minimum detection limit for combined fractions (g)

$$MDL_c = MDL_i + MDL_o$$

Where:

MDL_i	= reported minimum gravimetric detection limit for inorganic fraction (g)	=	0.00023	g
MDL_o	= reported minimum gravimetric detection limit for organic fraction (g)	=	0.00025	g
MDL_c	= minimum detection limit for combined fractions (g)	=	0.00048	g

17. Total condensable particulate matter (g)

$$m_{CPM} = MAXIMUM[m_T \quad or \quad MDL_c]$$

Where:

m_T	= total gravimetric result (g)	=	0.01861	g
MDL_c	= minimum detection limit for combined fractions (g)	=	0.00048	g
m_{CPM}	= total condensable particulate matter (g)	=	0.01861	g

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USEPA Method 5/202 (FPM/CPM)
Sample Emission Calculations for CPM

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Condensable particulate matter concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_{CPM}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=	0.01861	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
C_{sd}	= condensable particulate matter concentration (lb/dscf)	=	1.1145E-06	lb/dscf

2. Condensable particulate matter matter concentration (gr/dscf)

$$C_{sd} = \left(\frac{m_{CPM}}{V_{mstd}}\right)(15.43)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=	0.01861	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
15.43	= conversion factor (gr/g)	=	0.00	gr/g
C_{sd}	= condensable particulate matter concentration (gr/dscf)	=	0.0078	gr/dscf

3. Condensable particulate matter concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_{CPM}}{V_{mstd}}\right)(1000)(35.31)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=	0.01861	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
1000	= conversion factor (mg/g)	=	35	mg/g
35.31	= conversion factor (dscf/dscm)	=	460.00	dscf/dscm
C_{sd}	= condensable particulate matter concentration (mg/dscm)	=	17.8475	mg/dscm

4. Condensable particulate matter concentration (mg/Nm^3 dry)

$$C_{sd} = \left(\frac{m_{CPM}}{V_{mstd}}\right)(1000)(35.31)\left(\frac{68+460}{32+460}\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=	0.01861	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
1000	= conversion factor (mg/g)	=	35	mg/g
35.31	= conversion factor (dscf/dscm)	=	460.00	dscf/dscm
68	= standard temperature (°F)	=	12	°F
32	= normal temperature (°F)	=	68	°F
460	= °F to °R conversion constant	=	18	
C_{sd}	= condensable particulate matter concentration (mg/Nm^3 dry)	=	19.1535	mg/Nm^3 dry

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5. Condensable particulate matter concentration corrected to x% O_2 (gr/dscf example)

$$C_{sdx} = C_{sd}\left(\frac{20.9 - x}{20.9 - O_2}\right)$$

Where:

C_{sd}	= condensable particulate matter concentration (gr/dscf)	=	0.0078	gr/dscf
x	= oxygen content of corrected gas (%)	=	2000.0	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.3	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
C_{sdx}	= condensable particulate matter concentration corrected to x% O_2 (gr/dscf)	=	0.0058	gr/dscf @ x%O_2

6. Condensable particulate matter concentration corrected to y% CO_2 (gr/dscf example)

$$C_{sdy} = C_{sd}\left(\frac{y}{CO_2}\right)$$

Where:

C_{sd}	= condensable particulate matter concentration (gr/dscf)	=	0.0078	gr/dscf
y	= carbon dioxide content of corrected gas (%)	=	7.0	%
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	17.5	%
C_{sdy}	= condensable particulate matter concentration corrected to y% CO_2 (gr/dscf)	=	0.0054	gr/dscf @ y%CO_2

7. Condensable particulate matter concentration at actual gas conditions (gr/acf example)

$$C_a = C_{sd}\left(\frac{Q_{std}}{Q_a}\right)$$

Where:

C_{sd}	= condensable particulate matter concentration (gr/dscf)	=	0.0078	gr/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
Q_a	= volumetric flow rate at actual conditions (acfm)	=	266,323	acfm
C_a	= condensable particulate matter concentration at actual gas conditions (gr/acf)	=	0.0053	gr/acf

8. Condensable particulate matter rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_{CPM}}{V_{mstd}}\right)(2.205 \times 10^{-3})(Q_{std})(60)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=	0.01861	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= condensable particulate matter rate (lb/hr)	=	12.0414	lb/hr

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9. Condensable particulate matter rate (kg/hr)

$$E_{kg/hr} = \left(\frac{m_{CPM}}{V_{mstd}}\right)\left(\frac{(Q_{std})(60)}{1000}\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=	0.01861	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
1000	= conversion factor (g/kg)	=	35	g/kg
$E_{kg/hr}$	= condensable particulate matter rate (kg/hr)	=	5.4609	kg/hr

10. Condensable particulate matter rate (Ton/yr)

$$E_{T/yr} = \left(\frac{m_{CPM}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)(Q_{std})(60)\left(\frac{Cap}{2000}\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=	0.01861	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
Cap	= capacity factor for process (hours operated/year)	=	8,760	hours/yr
2000	= conversion factor (lb/Ton)	=	0	lb/Ton
$E_{T/yr}$	= condensable particulate matter rate (Ton/yr)	=	52.7412	Ton/yr

11. Condensable particulate matter rate - Production-based (lb/Mlb Coke)

$$E_{Rp} = \left(\frac{m_{CPM}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)\left(\frac{(Q_{std})(60)}{R_p}\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=	0.01861	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
R_p	= production rate (Mlb Coke/hr)	=	70	Mlb Coke/hr
E_{Rp}	= condensable particulate matter rate - production-based (lb/Mlb Coke)	=	0.1728	lb/Mlb Coke

12. Condensable particulate matter rate - Production-based (kg/Mlb Coke)

$$E_{Rp} = \left(\frac{m_{CPM}}{V_{mstd}}\right)\left(\frac{(Q_{std})(60)}{(1000)(R_p)}\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=	0.01861	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
1000	= conversion factor (g/kg)	=	35	g/kg
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
R_p	= production rate (Mlb Coke/hr)	=	70	Mlb Coke/hr
E_{Rp}	= condensable particulate matter rate - production-based (kg/Mlb Coke)	=	0.0784	kg/Mlb Coke

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USEPA Method 5/202 (FPM/CPM)
Sample Emission Calculations for Total Particulate (as PM10 & PM2.5)

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Total particulate (as pm10 & pm2.5)

$$m_{Part} = m_n + m_{CPM}$$

Where:

m_n	= total filterable particulate matter from 5 (g)	=	0.00888	
m_{CPM}	= total condensable particulate matter from 202 (g)	=	0.01861	
m_{Part}	= total particulate (as pm10 & pm2.5) (g)	=	0.02749	

2. Total particulate (as pm10 & pm2.5) concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_{Part}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)$$

Where:

m_{Part}	= total particulate (as pm10 & pm2.5) (g)	=	0.02749	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
C_{sd}	= total particulate (as pm10 & pm2.5) concentration (lb/dscf)	=	1.6464E-06	lb/dscf

3. Total particulate (as pm10 & pm2.5) concentration (gr/dscf)

$$C_{sd} = \left(\frac{m_{Part}}{V_{mstd}}\right)(15.43)$$

Where:

m_{Part}	= total particulate (as pm10 & pm2.5) (g)	=	0.02749	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
15.43	= conversion factor (gr/g)	=	0.00	gr/g
C_{sd}	= total particulate (as pm10 & pm2.5) concentration (gr/dscf)	=	0.0115	gr/dscf

4. Total particulate (as pm10 & pm2.5) concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_{Part}}{V_{mstd}}\right)(1000)(35.31)$$

Where:

m_{Part}	= total particulate (as pm10 & pm2.5) (g)	=	0.02749	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
1000	= conversion factor (mg/g)	=	35	mg/g
35.31	= conversion factor (dscf/dscm)	=	460.00	dscf/dscm
C_{sd}	= total particulate (as pm10 & pm2.5) concentration (mg/dscm)	=	26.3652	mg/dscm

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5. Total particulate (as pm10 & pm2.5) concentration (mg/Nm3 dry)

$$C_{sd} = \left(\frac{m_{Part}}{V_{mstd}}\right)(1000)(35.31)\left(\frac{68+460}{32+460}\right)$$

Where:

m_{Part}	= total particulate (as pm10 & pm2.5) (g)	=	0.02749	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
1000	= conversion factor (mg/g)	=	35	mg/g
35.31	= conversion factor (dscf/dscm)	=	460.00	dscf/dscm
68	= standard temperature (°F)	=	12	°F
32	= normal temperature (°F)	=	68	°F
460	= °F to °R conversion constant	=	18	
C_{sd}	= total particulate (as pm10 & pm2.5) concentration (mg/Nm3 dry)	=	28.2943	mg/Nm^3 dry

6. Total particulate (as pm10 & pm2.5) concentration corrected to x% O2 (gr/dscf example)

$$C_{sdx} = C_{sd}\left(\frac{20.9-x}{20.9-O_2}\right)$$

Where:

C_{sd}	= particulate concentration (gr/dscf)	=	0.0115	gr/dscf
x	= oxygen content of corrected gas (%)	=	2000.0	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.3	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
C_{sdx}	= total particulate (as pm10 & pm2.5) concentration corrected to x% O2 (gr/dscf)	=	0.0086	gr/dscf @ x%O_2

7. Total particulate (as pm10 & pm2.5) concentration corrected to y% CO2 (gr/dscf example)

$$C_{sdy} = C_{sd}\left(\frac{y}{CO_2}\right)$$

Where:

C_{sd}	= particulate concentration (gr/dscf)	=	0.0115	gr/dscf
y	= carbon dioxide content of corrected gas (%)	=	7.0	%
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	17.5	%
C_{sdy}	= total particulate (as pm10 & pm2.5) concentration corrected to y% CO2 (gr/dscf)	=	0.0079	gr/dscf @ y%CO_2

8. Total particulate (as pm10 & pm2.5) concentration at actual gas conditions (gr/acf example)

$$C_a = C_{sd}\left(\frac{Q_{std}}{Q_a}\right)$$

Where:

C_{sd}	= particulate concentration (gr/dscf)	=	0.0115	gr/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
Q_a	= volumetric flow rate at actual conditions (acfm)	=	266,323	acfm
C_a	= total particulate (as pm10 & pm2.5) concentration at actual gas conditions (gr/ac	=	0.0078	gr/acf

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9. Total particulate (as pm10 & pm2.5) rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_{Part}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)\left(Q_{std}\right)\left(60\right)$$

Where:

m_{Part}	= total particulate (as pm10 & pm2.5) (g)	=	0.02749	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= total particulate (as pm10 & pm2.5) rate (lb/hr)	=	17.7880	lb/hr

10. Total particulate (as pm10 & pm2.5) rate (kg/hr)

$$E_{kg/hr} = \left(\frac{m_{Part}}{V_{mstd}}\right)\left(\frac{\left(Q_{std}\right)\left(60\right)}{1000}\right)$$

Where:

m_{Part}	= total particulate (as pm10 & pm2.5) (g)	=	0.02749	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
1000	= conversion factor (g/kg)	=	35	g/kg
$E_{kg/hr}$	= total particulate (as pm10 & pm2.5) rate (kg/hr)	=	8.0671	kg/hr

11. Total particulate (as pm10 & pm2.5) rate (Ton/yr)

$$E_{T/yr} = \left(\frac{m_{Part}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)\left(Q_{std}\right)\left(60\right)\left(\frac{Cap}{2000}\right)$$

Where:

m_{Part}	= total particulate (as pm10 & pm2.5) (g)	=	0.02749	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
Cap	= capacity factor for process (hours operated/year)	=	8,760	hours/yr
2000	= conversion factor (lb/Ton)	=	0	lb/Ton
$E_{T/yr}$	= total particulate (as pm10 & pm2.5) rate (Ton/yr)	=	77.9116	Ton/yr

12. Total particulate (as pm10 & pm2.5) rate - Production-based (lb/Mlb Coke)

$$E_{Rp} = \left(\frac{m_{Part}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)\left(\frac{\left(Q_{std}\right)\left(60\right)}{R_p}\right)$$

Where:

m_{Part}	= total particulate (as pm10 & pm2.5) (g)	=	0.02749	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	1.000E+03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
R_p	= production rate (Mlb Coke/hr)	=	70	Mlb Coke/hr
E_{Rp}	= total particulate (as pm10 & pm2.5) rate - production-based (lb/Mlb Coke)	=	0.2553	lb/Mlb Coke

13. Total particulate (as pm10 & pm2.5) rate - Production-based (kg/Mlb Coke)

$$E_{Rp} = \left(\frac{m_{Part}}{V_{mstd}}\right)\left(\frac{\left(Q_{std}\right)\left(60\right)}{\left(1000\right)\left(R_p\right)}\right)$$

Where:

m_{Part}	= total particulate (as pm10 & pm2.5) (g)	=	0.02749	g
V_{mstd}	= volume metered, standard (dscf)	=	36.8122	dscf
1000	= conversion factor (g/kg)	=	35	g/kg
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
R_p	= production rate (Mlb Coke/hr)	=	70	Mlb Coke/hr
E_{Rp}	= total particulate (as pm10 & pm2.5) rate - production-based (kg/Mlb Coke)	=	0.1158	kg/Mlb Coke

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USEPA Method 8 (H2SO4)
H2SO4 Analyte Calculations

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Sulfate to H2SO4 conversion factor

$$K_a = \frac{MW_a}{n \times MW_{ion}}$$

Where:

MW_a	= molecular weight of H2SO4 (mg/mg-mole)	=	80.058	mg/mg-mole
MW_{ion}	= molecular weight of Sulfate ion (mg/mg-mole)	=	96.057	mg/mg-mole
n	= molar ratio of Sulfate to H2SO4	=	1.0	mole SO4--/mole H2
K_a	= conversion factor to convert mass SO4-- to mass H2SO4	=	0.833	

2. Total H2SO4 collected (mg)

$$m_a = K_a \times \frac{(S_{i-1} v_1 + S_{i-2} v_2)}{1000}$$

Where:

K_a	= conversion factor to convert mass SO4-- to mass H2SO4	=	0.833	
S_{i-1}	= Sulfate concentration of sample fraction 1 (mg/liter)	=	78.6900	mg/liter
v_1	= liquid volume of sample fraction 1 (ml)	=	262.3	ml
S_{i-2}	= Sulfate concentration of sample fraction 2 (mg/liter)	=	0.0000	mg/liter
v_2	= liquid volume of sample fraction 2 (ml)	=	0.0	ml
1000	= conversion factor (ml/liter)	=	1000	ml/liter
m_a	= total H2SO4 collected in sample (mg)	=	18.0000	mg

Note: Non-detects are treated as zero in summations.

DEFINITION
Fraction 1 = entire sample except last impinger containing applicable absorbing reagent.
Fraction 2 = last impinger containing applicable absorbing reagent, analyzed separately to evaluate collection efficiency.
If entire sample is analyzed as a single fraction, then data is included as Fraction 1 (Fraction 2 = 0).

3. Allowable blank subtraction (mg)

$$m_b = K_a \times B_i \times \frac{(v_1 + v_2)}{1000}$$

$$m_b = 0 \quad \text{if } B_i < MDL$$

Where:

K_a	= conversion factor to convert mass SO4-- to mass H2SO4	=	0.833	
B_F	= Sulfate concentration of blank (mg/liter)	=	0.0000	mg/liter
v_1	= liquid volume of sample fraction 1 (ml)	=	262.3	ml
v_2	= liquid volume of sample fraction 2 (ml)	=	0.0	ml
1000	= conversion factor (ml/liter)	=	1000	ml/liter
m_b	= allowable blank subtraction (mg)	=	0.0000	mg

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4. Total H2SO4 collected, corrected for blank (mg)

$$m_{nb} = m_a - m_b$$

Where:

m_a	= total H2SO4 collected in sample (mg)	=	18.0000	mg
m_b	= allowable blank subtraction (mg)	=	0.0000	mg
m_{nb}	= total H2SO4 collected, corrected for blank (mg)	=	18.0000	mg

5. Minimum detectable H2SO4 (mg)

$$m_{MDL} = K_a \times MDL \times \frac{(v_1 + v_2)}{1000}$$

Where:

K_a	= conversion factor to convert mass SO4-- to mass H2SO4	=	0.833	
MDL	= minimum detectable Sulfate concentration	=	1.300	mg/liter
v_1	= liquid volume of sample fraction 1 (ml)	=	262.3	ml
v_2	= liquid volume of sample fraction 2 (ml)	=	0.0	ml
1000	= conversion factor (ml/liter)	=	1000	ml/liter
m_{MDL}	= minimum detectable H2SO4 (mg)	=	0.2840	mg

6. Total H2SO4 value used in emission calculations (mg)

$$m_n = MAXIMUM \left[m_{nb} \quad or \quad < m_{MDL} \right]$$

Where:

m_{nb}	= total H2SO4 collected, corrected for blank (mg)	=	18.0000	mg
m_{MDL}	= minimum detectable H2SO4 (mg)	=	0.2840	mg
m_n	= total H2SO4 value used in emission calculations (mg)	=	18.0000	mg

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USEPA Method 8 (H2SO4)
H2SO4 Sample Calculations

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. H2SO4 concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{2.205 \times 10^{-3}}{1000}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	18.0000	mg
V_{mstd}	= volume metered, standard (dscf)	=	37.5890	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
C_{sd}	= H2SO4 concentration (lb/dscf)	=	1.0559E-06	lb/dscf

2. H2SO4 concentration (ppmdv)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{0.850}{1000}\right)\left(\frac{10^6}{MW}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	18.0000	mg
V_{mstd}	= volume metered, standard (dscf)	=	37.5890	dscf
MW	= molecular weight of H2SO4 (g/g-mole)	=	80.058	g/g-mole
0.850	= conversion factor (dscf/g-mole)	=	0.850	dscf/g-mole
1000	= conversion factor (mg/g)	=	1,000	mg/g
10^6	= conversion factor (ppm)	=	10^6	ppm
C_{sd}	= H2SO4 concentration (ppmdv)	=	5.0842	ppmdv

3. H2SO4 concentration (ppmwv)

$$C_w = C_{sd}\left(1 - \frac{B_w}{100}\right)$$

Where:

C_{sd}	= H2SO4 concentration (ppmdv)	=	5.0842	ppmdv
B_w	= actual water vapor in gas (% v/v)	=	20.9277	% v/v
100	= conversion factor (%)	=	100	%
C_w	= H2SO4 concentration (ppmwv)	=	4.0202	ppmwv

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4. H2SO4 concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)(35.31)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	18.0000	mg
V_{mstd}	= volume metered, standard (dscf)	=	37.5890	dscf
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
C_{sd}	= H2SO4 concentration (mg/dscm)	=	16.9087	mg/dscm

5. H2SO4 concentration (mg/Nm3 dry)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)(35.31)\left(\frac{68 + 460}{32 + 460}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	18.0000	mg
V_{mstd}	= volume metered, standard (dscf)	=	37.5890	dscf
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
68	= standard temperature (°F)	=	68	°F
32	= normal temperature (°F)	=	32	°F
460	= °F to °R conversion constant	=	460	
C_{sd}	= H2SO4 concentration (mg/Nm3 dry)	=	18.1459	mg/Nm^3 dry

6. H2SO4 concentration corrected to x% O2 (ppmdv example)

$$C_{sdx} = C_{sd}\left(\frac{20.9 - x}{20.9 - O_2}\right)$$

Where:

C_{sd}	= H2SO4 concentration (ppmdv)	=	5.0842	ppmdv
x	= oxygen content of corrected gas (%)	=	7.0	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.8	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
C_{sdx}	= H2SO4 concentration corrected to x% O2 (ppmdv)	=	3.9045	ppmdv @ x%O_2

7. H2SO4 concentration corrected to y% CO2 (ppmdv example)

$$C_{sdy} = C_{sd}\left(\frac{y}{CO_2}\right)$$

Where:

C_{sd}	= H2SO4 concentration (ppmdv)	=	5.0842	ppmdv
y	= carbon dioxide content of corrected gas (%)	=	12.0	%
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	17.1	%
C_{sdy}	= H2SO4 concentration corrected to y% CO2 (ppmdv)	=	3.5679	ppmdv @ y%CO_2

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8. H2SO4 concentration at actual gas conditions (lb/acf example)

$$C_a = C_{sd}\left(\frac{Q_{std}}{Q_a}\right)$$

Where:

C_{sd}	= H2SO4 concentration (lb/dscf)	=	1.0559E-06	lb/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	174,000	dscfm
Q_a	= volumetric flow rate at actual conditions (acfm)	=	257,000	acfm
C_a	= H2SO4 concentration at actual gas conditions (lb/acf)	=	7.1489E-07	lb/acf

9. H2SO4 rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{2.205\times10^{-3}}{1000}\right)(Q_{std})(60)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	18.0000	mg
V_{mstd}	= volume metered, standard (dscf)	=	37.5890	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	174,000	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= H2SO4 rate (lb/hr)	=	11.0235	lb/hr

10. H2SO4 rate (kg/hr)

$$E_{kg/hr} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{(Q_{std})(60)}{10^6}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	18.0000	mg
V_{mstd}	= volume metered, standard (dscf)	=	37.5890	dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	174,000	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
10^6	= conversion factor (mg/kg)	=	10^6	g/kg
$E_{kg/hr}$	= H2SO4 rate (kg/hr)	=	4.9993	kg/hr

11. H2SO4 rate (Ton/yr)

$$E_{T/yr} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{2.205\times10^{-3}}{1000}\right)(Q_{std})(60)\left(\frac{Cap}{2000}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	18.0000	mg
V_{mstd}	= volume metered, standard (dscf)	=	37.5890	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	174,000	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
Cap	= capacity factor for process (hours operated/year)	=	8,760	hours/yr
2000	= conversion factor (lb/Ton)	=	2,000	lb/Ton
$E_{T/yr}$	= H2SO4 rate (Ton/yr)	=	48.2831	Ton/yr

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12. H2SO4 rate - Production-based (lb/unit)

$$E_{RP} = \left(\frac{m_n}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)\left(\frac{Q_{std} \times 60}{1000 \times R_p}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	18.0000	mg
V_{mstd}	= volume metered, standard (dscf)	=	37.5890	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	174,000	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
1000	= conversion factor (mg/g)	=	1000	mg/g
R_p	= production rate (units/hr)	=	70	units/hour
E_{RP}	= H2SO4 rate - production based(lb/xxxx)	=	1.5690E-01	lb/unit

13. H2SO4 rate - Production-based (kg/unit)

$$E_{RP} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{Q_{std} \times 60}{10^6 \times R_p}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	18.0000	mg
V_{mstd}	= volume metered, standard (dscf)	=	37.5890	dscf
10^6	= conversion factor (mg/kg)	=	1,000,000	mg/kg
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	174,000	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
R_p	= production rate (units/hr)	=	70	units/hour
E_{RP}	= H2SO4 rate - production based(kg/xxxx)	=	7.1155E-02	kg/unit

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USEPA OTM 029 (Hydrogen Cyanide)
Sampling, Velocity and Moisture Sample Calculations

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Volume of gas metered, standard conditions (dscf)

$$V_{mstd} = \frac{(17.64)(V_m)\left(P_{bar} + \frac{\Delta H}{13.6}\right)(Y_d)}{(460 + T_m)}$$

Where:

P_{bar}	= barometric pressure (in. Hg)	=	29.76	in. Hg
T_m	= average dry gas meter temperature (°F)	=	66.13	°F
V_m	= volume of gas sample through the dry gas meter at meter conditions (dcf)	=	32.27	dcf
Y_d	= gas meter correction factor (dimensionless)	=	0.9884	
ΔH	= average pressure drop across meter box orifice (in. H_2O)	=	0.89	in. H_2O
17.64	= standard temperature to pressure ratio (°R/in. Hg)	=	17.64	°R/in. Hg
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in.H_2O/in. Hg
460	= °F to °R conversion constant	=	460	
V_{mstd}	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	31.896	dscf

2. Volume of gas metered standard, corrected for CO_2 absorption (dscf)

$$V_{actual} = \frac{V_{mstd}(100 - CO_{2Out})}{(100 - CO_{2In})}$$

Where:

V_{mstd}	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	31.896	dscf
CO_{2out}	= carbon dioxide at the outlet of the sampling train (dry volume %)	=	17.45	%
CO_{2in}	= carbon dioxide in the stack (dry volume %)	=	13.5	%
V_{actual}	= volume metered standard, corrected for CO_2 absorption (dscf)	=	33.422	dscf

3. Sample gas pressure (in. Hg)

$$P_s = P_{bar} + \left(\frac{P_g}{13.6}\right)$$

Where:

P_{bar}	= barometric pressure (in. Hg)	=	29.76	in. Hg
P_g	= sample gas static pressure (in. H_2O)	=	0.20	in. H_2O
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in. H_2O/in. Hg
P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg

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4. Actual water vapor pressure at sample gas temperature less than 212°F (in. Hg)

$$P_v = \frac{e^{\left(18.3036 - \frac{3816.44}{\frac{5}{9}(T_s - 32) + 273.15 - 46.13}\right)}}{25.4}$$

Where:

T_s	= average sample gas temperature (°F)	=	143.08	°F
18.3036	= Antoine coefficient	=	18.3036	°K
3816.44	= Antoine coefficient	=	3816.44	°K
273.15	= temperature conversion factor	=	273.15	°K
46.13	= Antoine coefficient	=	46.13	°K
25.4	= conversion factor	=	25.4	mm Hg/in. Hg
5/9	= Fahrenheit to Celsius conversion factor	=	5/9	°C/°F
32	= temperature conversion (°F)	=	32	°F
P_v	= vapor pressure, actual (in. Hg)	=	6.37	in. Hg

5. Water vapor pressure at gas temperature greater than 212°F (In. Hg)

$$P_v = P_s$$

Where:

P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg
P_v	= water vapor pressure, actual (in. Hg)	=	Previously Defined	in. Hg

6. Moisture measured in sample (% by volume)

$$B_{wo} = \frac{V_{wstd}}{(V_{mstd} + V_{wstd})}$$

Where:

V_{mstd}	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	31.896	dscf
V_{wstd}	= volume of water collected at standard conditions (scf)	=	0.00	scf
B_{wo}	= proportion of water measured in the gas stream by volume	=	0.2426	
		=	24.26	%

7. Saturated moisture content (% by volume)

$$B_{ws} = \frac{P_v}{P_s}$$

Where:

P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg
P_v	= water vapor pressure, actual (in. Hg)	=	6.37	in. Hg
B_{ws}	= proportion of water vapor in the gas stream by volume at saturated conditions		0.2198	
		=	21.98	%

8. *Actual water vapor in gas (% by volume)*

$$B_w = MINIMUM \quad [B_{wo}, B_{ws}]$$

Where:

B_{ws}	= *proportion of water vapor* in the gas stream by volume at saturated conditions	=	0.2198	
B_{wo}	= proportion of water measured in the gas stream by volume	=	0.2426	
B_w	= *actual water vapor in gas*	=	0.2198	
		=	21.98	%

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9. Nitrogen (plus carbon monoxide) in gas stream (% by volume, dry)

$$N_2 + CO \qquad = 100 - CO_2 - O_2$$

Where:

CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	13.5	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.7	%
100	= conversion factor (%)	=	100	%
N_2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=	79.85	%

10. Molecular weight of dry gas stream (lb/lb·mole)

$$M_d \qquad = (M_{CO_2})\frac{(CO_2)}{(100)} + (M_{O_2})\frac{(O_2)}{(100)} + (M_{N_2+CO})\frac{(N_2+CO)}{(100)}$$

Where:

M_{CO2}	= molecular weight of carbon dioxide (lb/lb·mole)	=	44.00	lb/lb·mole
M_{O2}	= molecular weight of oxygen (lb/lb·mole)	=	32.00	lb/lb·mole
M_{N2+CO}	= molecular weight of nitrogen and carbon monoxide (lb/lb·mole)	=	28.00	lb/lb·mole
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	13.5	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.7	%
N_2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=	79.9	%
100	= conversion factor (%)	=	100	%
M_d	= dry molecular weight of sample gas (lb/lb·mole)	=	30.90	lb/lb·mole

11. Molecular weight of sample gas (lb/lb·mole)

$$M_s \qquad = (M_d)(1 - B_w) + (M_{H_2O})(B_w)$$

Where:

B_w	= proportion of water vapor in the gas stream by volume	=	0.2198	
M_d	= dry molecular weight of sample gas (lb/lb·mole)	=	30.90	lb/lb·mole
M_{H2O}	= molecular weight of water (lb/lb·mole)	=	18.00	lb/lb·mole
M_s	= molecular weight of sample gas, wet basis (lb/lb·mole)	=	28.07	lb/lb·mole

12. Velocity of sample gas (ft/sec)

$$V_s \qquad = (K_p)(C_p)\left(\sqrt{\Delta P}\right)\left(\sqrt{\frac{(T_s + 460)}{(M_s)(P_s)}}\right)$$

Where:

K_p	= velocity pressure constant	=	85.49	
C_p	= pitot tube coefficient	=	0.83	
M_s	= wet molecular weight of sample gas, wet basis (lb/lb·mole)	=	28.07	lb/lb·mole
P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg
T_s	= average sample gas temperature (°F)	=	143.08	°F
$\sqrt{\Delta P}$	= average square roots of velocity heads of sample gas (in. H_2O)	=	0.601	$\sqrt{\text{in. } H_2O}$
460	= °F to °R conversion constant	=	460	
V_s	= sample gas velocity (ft/sec)	=	36.32	ft/sec

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13. Volumetric flow rate of sample gas at actual gas conditions (acfm)

$$Q_a = (60)(A_s)(V_s)$$

Where:

A_s	= cross sectional area of sampling location (ft^2)	=	132.73	ft^2
V_s	= sample gas velocity (ft/sec)	=	36.32	ft/sec
60	conversion factor (sec/min)	=	60	sec/min
Q_a	= volumetric flow rate at actual conditions (acfm)	=	289,259	acfm

14. Total flow of sample gas (scfm)

$$Q_s = (Q_a)\left(\frac{P_s}{29.92}\right)\left(\frac{68+460}{T_s+460}\right)$$

Where:

Q_a	= volumetric flow rate at actual conditions (acfm)	=	289,259	acfm
P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg
29.92	= standard pressure (in. Hg)	=	29.92	in. Hg
T_s	= average sample gas temperature (°F)	=	143.1	°F
68	= standard temperature (°F)	=	68	°F
460	= °F to °R conversion constant	=	460	
Q_s	= volumetric flow rate at standard conditions, wet basis (scfm)	=	252,017	scfm

15. Dry flow of sample gas (dscfm)

$$Q_{std} = (Q_s)(1 - B_w)$$

Where:

B_w	= proportion of water vapor in the gas stream by volume	=	0.2198	
Q_s	= volumetric flow rate at standard conditions, wet basis (scfm)	=	252,017	scfm
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	196,632	dscfm

16. Dry flow of sample gas corrected to 7%O_2 (dscfm)

$$Q_{std\,7} = (Q_{std})\left(\frac{20.9 - O_2}{20.9 - 7}\right)$$

Where:

Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	196,632	dscfm
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.7	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
7	= oxygen content of corrected gas (%)	=	7.0	%
Q_{std7}	= volumetric flow rate at STP and 7%O_2, dry basis (dscfm)	=	257,461	dscfm

17. Hourly time basis conversion of volumetric flow rate (Q_{std} example)

$$Q_{std-hr} = (Q_{std-min})(60)$$

Where

$Q_{std-min}$	= volumetric flow rate, english units (ft^3/min)	=	196,632	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
Q_{std-hr}	= volumetric flow rate, hourly basis (dscf/hr)	=	11,797,944	dscf/hr

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18. Metric Conversion of Gas Volumes (Q_{std} example)

$$Q_{std-metric} = (Q_{std-english})\left(\frac{60}{35.31}\right)$$

Where:

$Q_{std-english}$	= volumetric flow rate, english units (ft^3/min)	=	196,632	dscfm
35.31	= conversion factor (ft^3/m^3)	=	35.31	ft^3/m^3
60	= conversion factor (min/hr)	=	60	min/hr
$Q_{std-metric}$	= volumetric flow rate, metric units (m^3/hr)	=	334,125	dry std m^3/hr

19. Standard to Normal Conversion of Gas Volumes (Q_{std} example)

$$Q_{Normal} = (Q_{std-metric})\left(\frac{32+460}{68+460}\right)$$

Where:

$Q_{std-metric}$	= volumetric flow rate, metric units (dry std m^3/hr)	=	334,125	dry std m^3/hr
32	= normal temperature (°F)	=	32	°F
68	standard temperature (°F)	=	68	°F
460	= standard temperature in Rankine (68°F)	=	460	
Q_{Normal}	= volumetric flow rate, metric units (dry Nm^3/hr)	=	311,344	dry Nm^3/hr

20. Percent isokinetic (%)

$$I = \frac{(0.09450)(T_s+460)(V_{actual})}{(P_s)(V_s)\left(\frac{(D_n)^2(\pi)}{(144)(4)}\right)(\theta)(1-B_w)}$$

Where:

D_n	= diameter of nozzle (in)	=	0.250	in.
B_w	= proportion of water vapor in the gas stream by volume	=	0.2198	
P_s	= absolute sample gas pressure (in. Hg)	=	29.77	in. Hg
T_s	= average sample gas temperature (°F)	=	143.1	°F
V_{actual}	= Volume metered standard, corrected for CO_2 absorption (dscf)	=	33.422	dscf
V_s	= sample gas velocity (ft/sec)	=	36.32	ft/sec
θ	= total sampling time (min)	=	60	min
0.0945	= conversion constant	=	0.0945	
460	= °F to °R conversion constant	=	460	
I	= percent of isokinetic sampling (%)	=	110.37	%

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USEPA OTM 029
HCN Sample Calculations

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. HCN concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{actual}}\right)\left(\frac{2.205\times10^{-3}}{1000}\right)$$

Where:

m_n	= total HCN collected, *corrected* for applicable blank (mg)	=	28.6303	mg
V_{actual}	= volume metered standard, corrected for CO_2 absorption (dscf)	=	33.4219	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
C_{sd}	= HCN concentration (lb/dscf)	=	1.8889E-06	lb/dscf

2. HCN concentration (ppmdv)

$$C_{sd} = \left(\frac{m_n}{V_{actual}}\right)\left(\frac{0.850}{1000}\right)\left(\frac{10^6}{MW}\right)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (mg)	=	28.6303	mg
V_{actual}	= volume metered standard, corrected for CO_2 absorption (dscf)	=	33.4219	dscf
MW	= molecular weight of HCN (g/g-mole)	=	27.025	g/g-mole
0.850	= conversion factor (dscf/g-mole)	=	0.850	dscf/g-mole
1000	= conversion factor (mg/g)	=	1,000	mg/g
10^6	= conversion factor (ppm)	=	10^6	ppm
C_{sd}	= HCN concentration (ppmdv)	=	26.9429	ppmdv

3. HCN concentration (ppmwv)

$$C_w = C_{sd}\left(1-\frac{B_w}{100}\right)$$

Where:

C_{sd}	= HCN concentration (ppmdv)	=	26.9429	ppmdv
B_w	= actual water vapor in gas (% v/v)	=	21.9764	% v/v
100	= conversion factor (%)	=	100	%
C_w	= HCN concentration (ppmwv)	=	21.0218	ppmwv

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4. HCN concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_n}{V_{actual}}\right)(35.31)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (mg)	=	28.6303	mg
V_{actual}	= volume metered standard, corrected for CO_2 absorption (dscf)	=	33.4219	dscf
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
C_{sd}	= HCN concentration (mg/dscm)	=	30.2477	mg/dscm

5. HCN concentration (mg/Nm3 dry)

$$C_{sd} = \left(\frac{m_n}{V_{actual}}\right)(35.31)\left(\frac{68+460}{32+460}\right)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (mg)	=	28.6303	mg
V_{actual}	= volume metered standard, corrected for CO_2 absorption (dscf)	=	33.4219	dscf
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
68	= standard temperature (°F)	=	68	°F
32	= normal temperature (°F)	=	32	°F
460	= °F to °R conversion constant	=	460	
C_{sd}	= HCN concentration (mg/Nm3 dry)	=	32.4610	mg/Nm^3 dry

6. HCN concentration corrected to x% O2 (ppmdv example)

$$C_{sdx} = C_{sd}\left(\frac{20.9 - x}{20.9 - O_2}\right)$$

Where:

C_{sd}	= HCN concentration (ppmdv)	=	26.9429	ppmdv
x	= oxygen content of corrected gas (%)	=	7.0	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.7	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
C_{sdx}	= HCN concentration corrected to x% O2 (ppmdv)	=	20.5772	ppmdv @ x%O_2

7. HCN concentration corrected to y% CO2 (ppmdv example)

$$C_{sdy} = C_{sd}\left(\frac{y}{CO_2}\right)$$

Where:

C_{sd}	= HCN concentration (ppmdv)	=	26.9429	ppmdv
y	= carbon dioxide content of corrected gas (%)	=	12.0	%
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	13.5	%
C_{sdy}	= HCN concentration corrected to y% CO2 (ppmdv)	=	23.9492	ppmdv @ y%CO_2

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8. HCN concentration at actual gas conditions (lb/acf example)

$$C_a = C_{sd}\left(\frac{Q_{std}}{Q_a}\right)$$

Where:

C_{sd}	= HCN concentration (lb/dscf)	=	1.8889E-06	lb/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
Q_a	= volumetric flow rate at actual conditions (acfm)	=	266,323	acfm
C_a	= HCN concentration at actual gas conditions (lb/acf)	=	1.2771E-06	lb/acf

9. HCN rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_n}{V_{actual}}\right)\left(\frac{2.205\times10^{-3}}{1000}\right)(Q_{std})(60)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (mg)	=	28.6303	mg
V_{actual}	= volume metered standard, corrected for CO_2 absorption (dscf)	=	33.4219	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= HCN rate (lb/hr)	=	20.4075	lb/hr

10. HCN rate (kg/hr)

$$E_{kg/hr} = \left(\frac{m_n}{V_{actual}}\right)\left(\frac{(Q_{std})(60)}{10^6}\right)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (mg)	=	28.6303	mg
V_{actual}	= volume metered standard, corrected for CO_2 absorption (dscf)	=	33.4219	dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	180,068	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
10^6	= conversion factor (mg/kg)	=	10^6	g/kg
$E_{kg/hr}$	= HCN rate (kg/hr)	=	9.2551	kg/hr

11. HCN rate - Fd-based (lb/MMBtu)

$$E_{Fd} = \left(\frac{m_n}{V_{actual}}\right)\left(\frac{2.205\times10^{3}}{1000}\right)(F_d)\left(\frac{209}{209-O_2}\right)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (mg)	=	28.6303	mg
V_{actual}	= volume metered standard, corrected for CO_2 absorption (dscf)	=	33.4219	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
F_d	= ratio of gas volume to heat content of fuel (dscf/MMBtu)	=	9,780	dscf/MMBtu
O_2	= proportion of oxygen in the gas stream by volume (%)	=	2.7	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
E_{Fd}	= HCN rate (lb/MMBtu)	=	2.1214E-02	lb/MMBtu

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12. HCN rate - Fc-based (lb/MMBtu)

$$E_{Fc} = \left(\frac{m_n}{V_{actual}}\right)\left(\frac{2.205\times10^{-3}}{1000}\right)(F_c)\left(\frac{100}{CO_2}\right)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (mg)	=	28.6303	mg
V_{actual}	= volume metered standard, corrected for CO_2 absorption (dscf)	=	33.4219	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
F_c	= ratio of gas volume to heat content of fuel (dscf/MMBtu)	=	1,800	dscf/MMBtu
CO_2	= proportion of oxygen in the gas stream by volume (%)	=	13.5	%
100	= conversion factor	=	100	
E_{Fc}	= HCN rate (lb/MMBtu)	=	2.5185E-02	lb/MMBtu

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Marathon

CleanAir Project No. 12461

Garyville, LA

FCCU

CEM Field Sample Calculations for THC FCCU

Sample data taken from Run 1
and Channel 3

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Average of a calibration series

$$C_{mce} = \frac{(C_1 + C_2 + C_3)}{3}$$

Where:

C_1, C_2, C_3 = concentrations of 3 consecutive gas samples that are representative of the calibration gas

C_{mce}	= average concentration of a calibration series In this case the low cal series for channel 3	=	24.181	ppmwv

2a. Calibration Error Check for Hydrocarbons (5% of actual calibration gas value error allowed by Method 25A)

$$E_{HC} = abs\left|\frac{C_{mce} - C_{ma}}{C_{ma}}\right| \le l_{cal}$$

Where:

C_{mce}	= average concentration of a calibration series In this case the low cal series for channel 3	=	24.181	ppmwv
C_{ma}	= concentration of actual calibration gas value	=	24.700	ppmwv
l_{cal}	= limit for calibration error for hydrocarbons	=	5.0%	
E_{HC}	= calibration error check value	=	2.10%	**Pass**

2b. Calibration Error Check for non-Hydrocarbons (2% of Instrument Span)

$$E = abs\left|\frac{C_{mce} - C_{ma}}{Span}\right| \le l_{cal}$$

Where:

C_{mce}	= average concentration of a calibration series In this case the low cal series for channel 3	=	24.181	ppmwv
C_{ma}	= concentration of actual calibration gas value	=	24.700	ppmwv
Span	= instrument span value	=	85.600	
l_{cal}	= limit for calibration error for non-hydrocarbons	=	2.0%	
E	= calibration error check value	=	NA	

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3. System Bias as Percent of Span Value (5% is allowed)

$$E_{Bias} = abs\left|\frac{C_{mf} - C_{mce}}{Span}\right| \le l_{bias}$$

Where:

C_{mce}	= average concentration of a calibration series in this case the Low cal series for channel 3	=	24.181	ppmwv
C_{mf}	= calibration error response concentration for Cal01	=	25.309	ppmwv
Span	= instrument span value	=	85.600	ppmwv
l_{bias}	= limit for system bias error	=	5.0%	
E_{bias}	= calibration bias error check value	=	1.32%	**Pass**

4. System Drift as Percent of Span Value (3%)

$$E_{Drift} = abs\left|\frac{C_{mf} - C_{mi}}{Span}\right| \le l_{drift}$$

Where:

C_{mf}	= calibration error response concentration for Cal01 (final)	=	25.309	ppmwv
C_{mi}	= calibration error response concentration for Cal00 (initial)	=	24.181	ppmwv
Span	= instrument span value	=	85.600	ppmwv
l_{drift}	= limit for system drift error	=	3.0%	
E_{drift}	= calibration drift error check value	=	1.32%	**Pass**

5. Average Concentration for an entire Run

$$C = \frac{\sum_{i=1}^{N} C_i}{N}$$

Where:

C_i	= All concentration readings for the entirety of Run 1 for the monitor looking for THC on channel 3	=	2.222	ppmwv
N	= total number of readings in Run 1	=	69	
C	= average THC concentration for Run 1	=	3.068	ppmwv

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6. Drift-Corrected Average Concentration for an entire Run

$$C_{DC} = \left(C - \frac{C_{oi} + C_{of}}{2} \right) \left(\frac{C_{ma}}{\frac{C_{mi} + C_{mf}}{2} - \frac{C_{oi} + C_{of}}{2}} \right)$$

C_{ma}	= concentration of actual calibration gas value	=	24.700	ppmwv
C	= average THC concentration for Run 1	=	3.068	ppmwv
C_{mf}	= calibration error response concentration for Cal01 (final)	=	25.309	ppmwv
C_{mi}	= calibration error response concentration for Cal00 (initial)	=	24.181	ppmwv
C_{of}	= calibration error response concentration for Cal01 (final) for zero gas	=	-0.320	ppmwv
C_{oi}	= calibration error response concentration for Cal00 (initial) for zero gas	=	-0.833	ppmwv
C_{DC}	= drift corrected average concentration for Run 1	=	3.555	ppmwv

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Marathon

CleanAir Project No. 12461

Garyville, LA

FCCU

CEM Emissions Sample Calculations
for THC FCCU

Sample data taken from Run 1
and Channel 3

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. THC concentration (ppmdv)

$$C(ppmdv) = k_1 \times C_{DC} \quad if \quad dry \quad gas$$

$$C(ppmdv) = \frac{k_1 \times C_{DC}}{\left(1 - B_W/100\right)} \quad if \quad wet \quad gas$$

Where:

C_{DC}	= drift corrected average concentration	=	3.555	ppmwv
B_w	= actual water vapor in gas (% v/v)	=	0.000	% v/v
100	= conversion factor to change percentage to decimal	=	100	
k_1	= ppm/% to ppm conversion factor for diluent gases	=	1	
C (ppmdv)	= THC concentration (ppmdv)	=	3.555	ppmdv

2. THC concentration (ppmwv)

$$C(ppmwv) = k_1 \times C_{DC} \quad if \quad wet \quad gas$$

$$C(ppmwv) = k_1 \times C_{DC} \times \left(1 - B_W/100\right) \quad if \quad dry \quad gas$$

Where:

C_{DC}	= drift corrected average concentration	=	3.555	ppmwv
B_w	= actual water vapor in gas (% v/v)	=	0.000	% v/v
100	= conversion factor to change percentage to decimal	=	100	
k_1	= ppm/% to ppm conversion factor for diluent gases	=	1	
C (ppmwv)	= THC concentration (ppmwv)	=	3.555	ppmwv

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Garyville, LA

FCCU

3. THC concentration (lb/dscf)

$$C(lb/dscf) = \frac{C(ppmdv) \times MW(gas)}{10^6 \, ppm \times 385.3}$$

Where:

C (ppmdv)	= THC concentration (ppmdv)	=	3.555	ppmdv
MW	= Molecular Weight of THC gas	=	44.0972	lb/lb-mole
10^6	= conversion factor from decimal to ppm	=	1.00E+06	
385.3	= molar volume	=	385.3	dscf/lb-mole
C (lb/dscf)	= THC concentration (lb/dscf)	=	4.069E-07	lb/dscf

4. THC concentration (lb/scf)

$$C(lb/scf) = C(lb/dscf) \times \frac{Q_{std}}{Q_s}$$

Where:

C (lb/dscf)	= THC concentration (lb/dscf)	=	4.069E-07	lb/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	174046.5055	dscf/min
Q_s	= volumetric flow rate (standard cubic feet/min)	=	222433.047	scf/min
C (lb/scf)	= THC concentration (lb/scf)	=	3.184E-07	lb/scf

5. THC concentration (lb/acf)

$$C(lb/acf) = C(lb/dscf) \times \frac{Q_{std}}{Q_a}$$

Where:

C (lb/dscf)	= THC concentration (lb/dscf)	=	4.069E-07	lb/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	174046.5055	dscf/min
Q_a	= volumetric flow rate (actual cubic feet/min)	=	257329.0149	acf/min
C (lb/acf)	= THC concentration (lb/acf)	=	2.752E-07	lb/acf

6. THC concentration (%dv)

$$C(\%dv) = C(ppmdv) \times \frac{100}{10^6}$$

Where:

C (ppmdv)	= THC concentration (ppmdv)	=	3.555	ppmdv
100	= conversion factor from decimal to percentage	=	1.00E+02	
10^6	= conversion factor from decimal to ppm	=	1.00E+06	
C (%dv)	= THC concentration (%dv)	=	0.0004%	%dv

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7. THC concentration (mg/dscm)

$$C\left(mg/dscm\right) = C\left(lb/dscf\right) \times k_2 \times 35.31$$

Where:

C (lb/dscf)	= THC concentration (lb/dscf)	=	4.069E-07	lb/dscf
k_2	= conversion factor from lb to mg	=	453515	mg/lb
35.31	= conversion factor from dscf to dscm	=	35.31	ft^3/m^3
C (mg/dscm)	= THC concentration (mg/dscm)	=	6.516	mg/dscm

8. THC concentration (mg/Nm3 dry)

$$C\left(mg/Nm^3\ dry\right) = C\left(lb/dscf\right) \times k_2 \times 35.31 \times \left(\frac{68+460}{32+460}\right)$$

Where:

C (lb/dscf)	= THC concentration (lb/dscf)	=	4.069E-07	lb/dscf
k_2	= conversion factor from lb to mg	=	453515	mg/lb
35.31	= conversion factor from dscf to dscm	=	35.31	ft^3/m^3
68	= standard temperature (°F)	=	68	°F
32	= normal temperature (°F)	=	32	°F
460	= °F to °R conversion constant	=	460	
C (mg/Nm3 dr	= THC concentration (mg/Nm3 dry)	=	6.992	mg/Nm^3 dry

9. THC concentration corrected to 7% O2 (ppmdv example)

$$C(ppmdv@x\%02) = C(ppmdv) \times \left(\frac{20.9-x}{20.9-O_2}\right)$$

Where:

C (ppmdv)	= THC concentration (ppmdv)	=	3.555	ppmdv
x	= oxygen content of corrected gas (%)	=	7.00	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	1.256	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
C (ppmdv - O2	= THC concentration corrected to 7% O2 (ppmdv example)	=	2.516	ppmdv @ 7%O2

10. THC concentration corrected to 12% CO2 (ppmdv example)

$$C(ppmdv@y\%C0_2) = C(ppmdv) \times \left(\frac{y}{CO_2}\right)$$

Where:

C (ppmdv)	= THC concentration (ppmdv)	=	3.555	ppmdv
y	= carbon dioxide content of corrected gas (%)	=	12.00	%
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	18.771	%
C (ppmdv -CC	= THC concentration corrected to 12% CO2 (ppmdv example)	=	2.273	ppmdv @ 12%CO2

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PARAMETERS

C

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: RWK

Date: 05/14

CleanAir

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 5/202 (Particulate/CPM)
Sampling, Velocity and Moisture Parameters

Run No.		1	2*	3	Average
Date (2014)		Mar 18	Mar 18	Mar 19	
Start Time (approx.)		10:45	17:56	09:14	
Stop Time (approx.)		12:01	19:09	10:23	
Sampling Conditions					
Y_d	Dry gas meter correction factor	0.9931	0.9931	0.9931	
C_p	Pitot tube coefficient	0.8310	0.8310	0.8310	
P_g	Static pressure (in. H_2O)	0.2000	0.2000	0.2000	
A_s	Sample location area (ft^2)	132.7323	132.7323	132.7323	
P_{bar}	Barometric pressure (in. Hg)	29.76	29.76	29.96	**29.8600**
D_n	Nozzle diameter (in.)	0.2760	0.2750	0.2750	
O_2	Oxygen (dry volume %)[1]	2.3000	2.3000	2.3000	**2.3000**
CO_2	Carbon dioxide (dry volume %)[1]	17.4500	17.4000	17.5000	**17.4750**
N_2+CO	Nitrogen plus carbon monoxide (dry volume %)	80.2500	80.3000	80.2000	**80.2250**
V_{lc}	Total Liquid collected (ml)	250.50	234.10	225.10	
V_m	Volume metered, meter conditions (ft^3)	37.4180	39.0360	38.6940	
T_m	Dry gas meter temperature (°F)	71.7083	76.6458	69.2917	
T_s	Sample temperature (°F)	144.1667	144.3333	144.4583	**144.3125**
ΔH	Meter box orifice pressure drop (in. H_2O)	1.3632	1.3167	1.3358	
θ	Total sampling time (min)	60.0	60.0	60.0	
Flow Results					
V_{wstd}	Volume of water collected (ft^3)	11.7885	11.0167	10.5932	**11.1909**
V_{mstd}	Volume metered, standard (dscf)	36.8122	38.0463	38.4949	**37.6536**
P_s	Sample gas pressure, absolute (in. Hg)	29.7747	29.7747	29.9747	**29.8747**
P_v	Vapor pressure, actual (in. Hg)	6.5434	6.5711	6.5919	**6.5676**
B_{wo}	Moisture measured in sample (% by volume)	24.2559	22.4543	21.5800	**22.9179**
B_{ws}	Saturated moisture content (% by volume)	21.9764	22.0693	21.9915	**21.9840**
B_w	Actual water vapor in gas (% by volume)	21.9764	22.0693	21.5800	**21.7782**
$\sqrt{\Delta P}$	Velocity head ($\sqrt{}$in. H_2O)	0.6073	0.6016	0.6065	**0.6069**
M_d	MW of sample gas, dry (lb/lb-mole)	30.8840	30.8760	30.8920	**30.8880**
M_s	MW of sample gas, wet (lb/lb-mole)	28.0526	28.0344	28.1099	**28.0812**
V_s	Velocity of sample (ft/sec)	36.6953	36.3651	36.4920	**36.5937**
%I	Isokinetic sampling (%)	98.9007	104.0486	103.5806	**101.2406**
Q_a	Volumetric flow rate, actual (acfm)	292,239	289,609	290,620	**291,430**
Q_s	Volumetric flow rate, standard (scfm)	254,157	251,800	254,323	**254,240**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	198,302	196,230	199,440	**198,871**
Q_{std7}	Volumetric flow rate, dry std@7%O_2 (dscfm)	265,354	262,581	266,877	**266,116**
Q_a	Volumetric flow rate, actual (acf/hr)	17,534,359	17,376,567	17,437,187	**17,485,773**
Q_s	Volumetric flow rate, standard (scf/hr)	15,249,407	15,108,009	15,259,395	**15,254,401**
Q_{std}	*Volumetric flow rate, dry standard (dscf/hr)*	11,898,138	11,773,775	11,966,421	**11,932,280**
Q_a	Volumetric flow rate, actual (m^3/hr)	496,583	492,115	493,831	**495,207**
Q_s	Volumetric flow rate, standard (m^3/hr)	431,872	427,868	432,155	**432,014**
Q_{std}	Volumetric flow rate, dry standard (dry m^3/hr)	336,962	333,440	338,896	**337,929**
Q_{std7}	Volumetric flow rate, dry std@7%O_2 (dry m^3/hr)	450,899	446,186	453,487	**452,193**
Q_s	Volumetric flow rate, normal (Nm^3/hr)	402,426	398,695	402,690	**402,558**
Q_{std}	Volumetric flow rate, dry normal (Nm^3/hr)	313,988	310,706	315,790	**314,889**
Q_{std7}	Volumetric flow rate, dry normal @7%O_2 (Nm^3/hr)	420,156	415,764	422,567	**421,362**

Comments:

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JKL

Average includes 2 runs. * indicates that the run is not included in the average.

[1] *Run 1 O_2 and CO_2 values are an average of Runs 2 & 3. The IGS bag for Run 1 developed a leak and was unusable.*

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 5/202 (FPM/CPM)
Emission Parameters for FPM

Run No.		1	2*	3	Average
Date (2014)		Mar 18	Mar 18	Mar 19	
Start Time (approx.)		10:45	17:56	09:14	
Stop Time (approx.)		12:01	19:09	10:23	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	70	71	70	**70**
P_1	L/G	18	18	19	**18**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	2.3000	2.3000	2.3000	**2.3000**
CO_2	Carbon dioxide (dry volume %)	17.4500	17.4000	17.5000	**17.4750**
T_s	Sample temperature (°F)	144.1667	144.3333	144.4583	**144.3125**
B_w	Actual water vapor in gas (% by volume)	21.9764	22.0693	21.5800	**21.7782**
Gas Flow Rate1					
Q_a	Volumetric flow rate, actual (acfm)	267,664	264,152	272,220	**269,942**
Q_s	Volumetric flow rate, standard (scfm)	232,087	228,814	237,105	**234,596**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	180,974	178,422	184,882	**182,928**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	36.8122	38.0463	38.4949	**37.6536**
%I	Isokinetic sampling (%)	98.9007	104.0486	103.5806	**101.2406**
Laboratory Data					
m_{filter}	Matter collected on filter(s) (g)	0.00576	0.01799	0.01510	
m_s	Matter collected in solvent rinse(s) (g)	0.00312	0.00243	0.00496	
m_n	Total filterable particulate matter (g)	0.00888	0.02042	0.02006	
n_{MDL}	Number of non-detectable fractions	N/A	N/A	N/A	
DLC	Detection level classification	ADL	ADL	ADL	
Filterable Particulate Matter Results					
C_{sd}	Particulate Concentration (lb/dscf)	5.3190E-07	1.1835E-06	1.1490E-06	**8.4047E-07**
C_a	Particulate Concentration (lb/acf)	3.5963E-07	7.9937E-07	7.8039E-07	**5.7001E-07**
C_{sd}	Particulate Concentration (gr/dscf)	0.0037	0.0083	0.0080	**0.0059**
C_a	Particulate Concentration (gr/acf)	0.0025	0.0056	0.0055	**0.0040**
C_{sd}	Particulate Concentration (mg/dscm)	8.5176	18.9514	18.4003	**13.4590**
C_a	Particulate Concentration (mg/m^3 (actual,wet))	5.7590	12.8008	12.4968	**9.1279**
C_{sd}	Particulate Concentration (mg/Nm^3 dry)	9.1409	20.3381	19.7467	**14.4438**
$E_{lb/hr}$	Particulate Rate (lb/hr)	5.7756	12.6693	12.7463	**9.2609**
$E_{T/yr}$	Particulate Rate (Ton/yr)	25.2972	55.4915	55.8286	**40.5629**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.0829	0.1791	0.1818	**0.1324**

Comments:

Average includes 2 runs. * indicates that the run is not included in the average.

[1]Gas Flow Rate calculated using M2F and 2H test runs.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 5/202 (FPM/CPM)
Emission Parameters for CPM

Run No.		1	2*	3	Average
Date (2014)		Mar 18	Mar 18	Mar 19	
Start Time (approx.)		10:45	17:56	09:14	
Stop Time (approx.)		12:01	19:09	10:23	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	70	71	70	70
P_1	L/G	18	18	19	18
Cap	*Capacity factor (hours/year)*	8,760	8,760	8,760	8,760
Gas Conditions					
O_2	Oxygen (dry volume %)	2.3000	2.3000	2.3000	2.3000
CO_2	Carbon dioxide (dry volume %)	17.4500	17.4000	17.5000	17.4750
T_s	Sample temperature (°F)	144.1667	144.3333	144.4583	144.3125
B_w	Actual water vapor in gas (% by volume)	21.9764	22.0693	21.5800	21.7782
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	267,664	264,152	272,220	269,942
Q_s	Volumetric flow rate, standard (scfm)	232,087	228,814	237,105	234,596
Q_{std}	Volumetric flow rate, dry standard (dscfm)	180,974	178,422	184,882	182,928
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	36.8122	38.0463	38.4949	37.6536
%I	Isokinetic sampling (%)	98.9007	104.0486	103.5806	101.2406
Laboratory Data					
m_{CPMi}	Total Inorganic CPM Result (g)	0.00753	0.04912	0.00692	
m_{CPMo}	Total Organic CPM Result (g)	0.00110	0.00029	0.00025	
m_{CPM}	Total CPM (g)	0.00864	0.04941	0.00717	
n_{MDL}	Number of non-detectable fractions	N/A	N/A	N/A	
DLC	Detection level classification	ADL	ADL	ADL	
Condensable Particulate Matter Results					
C_{sd}	Particulate Concentration (lb/dscf)	5.1728E-07	2.8638E-06	4.1082E-07	4.6405E-07
C_a	Particulate Concentration (lb/acf)	3.4975E-07	1.9344E-06	2.7902E-07	3.1438E-07
C_{sd}	Particulate Concentration (gr/dscf)	0.0036	0.0200	0.0029	0.0032
C_a	Particulate Concentration (gr/acf)	0.0024	0.0135	0.0020	0.0022
C_{sd}	Particulate Concentration (mg/dscm)	8.2835	45.8603	6.5788	7.4311
C_a	Particulate Concentration (mg/m^3 (actual,wet))	5.6007	30.9766	4.4681	5.0344
C_{sd}	Particulate Concentration (mg/Nm^3 dry)	8.8896	49.2160	7.0601	7.9749
$E_{lb/hr}$	Particulate Rate (lb/hr)	5.6169	30.6584	4.5572	5.0871
$E_{T/yr}$	Particulate Rate (Ton/yr)	24.6019	134.2836	19.9607	22.2813
E_{RP}	Particulate Rate - Production-based (lb/Mlb Coke)	0.0806	0.4335	0.0650	0.0728

Comments:

Average includes 2 runs. * indicates that the run is not included in the average.

[1]Gas Flow Rate calculated using M2F and 2H test runs.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

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USEPA Method 5/202 (FPM/CPM)
Emission Parameters for CPM
Separate Inorganic and Organic Results

Run No.		1	2*	3	Average
Date (2014)		Mar 18	Mar 18	Mar 19	
Start Time (approx.)		10:45	17:56	09:14	
Stop Time (approx.)		12:01	19:09	10:23	
Condensable Particulate Matter Results - Inorganic Fraction					
C_{sd}	Particulate Concentration (lb/dscf)	4.5117E-07	2.8468E-06	3.9650E-07	**4.2383E-07**
C_a	Particulate Concentration (lb/acf)	3.0504E-07	1.9229E-06	2.6929E-07	**2.8717E-07**
C_{sd}	Particulate Concentration (gr/dscf)	0.0032	0.0199	0.0028	**0.0030**
C_a	Particulate Concentration (gr/acf)	0.0021	0.0135	0.0019	**0.0020**
C_{sd}	Particulate Concentration (mg/dscm)	7.2248	45.5877	6.3495	**6.7871**
C_a	Particulate Concentration (mg/m^3 (actual,wet))	4.8849	30.7924	4.3123	**4.5986**
C_{sd}	Particulate Concentration (mg/Nm^3 dry)	7.7534	48.9234	6.8140	**7.2837**
$E_{lb/hr}$	Particulate Rate (lb/hr)	4.8990	30.4761	4.3984	**4.6487**
E_{RP}	Particulate Rate - Production-based (lb/Mlb Coke)	0.0703	0.4309	0.0627	**0.0665**
Condensable Particulate Matter Results - Organic Fraction					
C_{sd}	Particulate Concentration (lb/dscf)	6.6114E-08	1.7026E-08	1.4320E-08	**4.0217E-08**
C_a	Particulate Concentration (lb/acf)	4.4702E-08	1.1500E-08	9.7257E-09	**2.7214E-08**
C_{sd}	Particulate Concentration (gr/dscf)	0.0005	0.0001	0.0001	**0.0003**
C_a	Particulate Concentration (gr/acf)	0.0003	0.0001	0.0001	**0.0002**
C_{sd}	Particulate Concentration (mg/dscm)	1.0587	0.2726	0.2293	**0.6440**
C_a	Particulate Concentration (mg/m^3 (actual,wet))	0.7158	0.1842	0.1557	**0.4358**
C_{sd}	Particulate Concentration (mg/Nm^3 dry)	1.1362	0.2926	0.2461	**0.6911**
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.7179	0.1823	0.1589	**0.4384**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.0103	0.0026	0.0023	**0.0063**

Comments:

Average includes 2 runs. * indicates that the run is not included in the average.

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USEPA Method 5/202 (FPM/CPM)
Emission Parameters for Total Particulate (as PM10 & PM2.5)

Run No.		1	2*	3	Average
Date (2014)		Mar 18	Mar 18	Mar 19	
Start Time (approx.)		10:45	17:56	09:14	
Stop Time (approx.)		12:01	19:09	10:23	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	70	71	70	70
P_1	L/G	18	18	19	18
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760
Gas Conditions					
O_2	Oxygen (dry volume %)	2.3000	2.3000	2.3000	2.3000
CO_2	Carbon *dioxide* (dry volume %)	17.4500	17.4000	17.5000	17.4750
T_s	Sample temperature (°F)	144.1667	144.3333	144.4583	144.3125
B_w	Actual water vapor in gas (% by volume)	21.9764	22.0693	21.5800	21.7782
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	267,664	264,152	272,220	269,942
Q_s	Volumetric flow rate, standard (scfm)	232,087	228,814	237,105	234,596
Q_{std}	Volumetric flow rate, dry standard (dscfm)	180,974	178,422	184,882	182,928
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	36.8122	38.0463	38.4949	37.6536
%I	Isokinetic sampling (%)	98.9007	104.0486	103.5806	101.2406
Laboratory Data					
m_n	Total filterable particulate matter (g)	0.00888	0.02042	0.02006	
m_{CPM}	Total condensable particulate matter (g)	0.00864	0.04941	0.00717	
m_{Part}	Total particulate (as pm10 & pm2.5) (g)	0.01752	0.06983	0.02723	
n_{MDL}	Number of non-detectable fractions	N/A	N/A	N/A	
DLC	Detection level classification	ADL	ADL	ADL	
Total Particulate (as PM10 & PM2.5) Results					
C_{sd}	Particulate Concentration (lb/dscf)	1.0492E-06	4.0473E-06	1.5599E-06	1.3045E-06
C_a	Particulate Concentration (lb/acf)	7.0938E-07	2.7338E-06	1.0594E-06	8.8439E-07
C_{sd}	Particulate Concentration (gr/dscf)	0.0073	0.0283	0.0109	0.0091
C_a	Particulate Concentration (gr/acf)	0.0050	0.0191	0.0074	0.0062
C_{sd}	Particulate Concentration (mg/dscm)	16.8012	64.8117	24.9791	20.8901
C_a	Particulate Concentration (mg/m^3 (actual,wet))	11.3597	43.7774	16.9649	14.1623
C_{sd}	Particulate Concentration (mg/Nm^3 dry)	18.0305	69.5540	26.8068	22.4187
$E_{lb/hr}$	Particulate Rate (lb/hr)	11.3925	43.3277	17.3035	14.3480
$E_{T/yr}$	Particulate Rate (Ton/yr)	49.8991	189.7751	75.7894	62.8442
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.1635	0.6127	0.2468	0.2052

Comments:

Average includes 2 runs. * indicates that the run is not included in the average.

[1]Gas Flow Rate calculated using M2F and 2H test runs.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

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USEPA Method 5/202 (Particulate/CPM)
Sampling, Velocity and Moisture Parameters

Run No.		4	5	6	Average
Date (2014)		Mar 19	Mar 19	Mar 19	
Start Time (approx.)		11:23	13:27	15:31	
Stop Time (approx.)		12:32	14:38	16:41	
Sampling Conditions					
Y_d	Dry gas meter correction factor	0.9931	0.9931	0.9931	
C_p	Pitot tube coefficient	0.8310	0.8310	0.8310	
P_g	Static pressure (in. H_2O)	0.2000	0.2000	0.2000	
A_s	Sample location area (ft^2)	132.7323	132.7323	132.7323	
P_{bar}	Barometric pressure (in. Hg)	29.95	29.96	29.96	29.9567
D_n	Nozzle diameter (in.)	0.2750	0.2750	0.2750	
O_2	Oxygen (dry volume %)	4.3000	2.8000	1.4000	2.8333
CO_2	Carbon dioxide (dry volume %)	15.1000	16.8000	17.9000	16.6000
N_2+CO	Nitrogen plus carbon monoxide (dry volume %)	80.6000	80.4000	80.7000	80.5667
V_{lc}	Total Liquid collected (ml)	211.10	202.80	217.00	
V_m	Volume metered, meter conditions (ft^3)	40.2070	39.6500	38.9130	
T_m	Dry gas meter temperature (°F)	79.1458	82.0417	86.9375	
T_s	Sample temperature (°F)	144.7083	144.6250	144.2083	144.5139
ΔH	Meter box orifice pressure drop (in. H_2O)	1.3738	1.3446	1.2983	
θ	Total sampling time (min)	60.0	60.0	60.0	
Flow Results					
V_{wstd}	Volume of water collected (ft^3)	9.9344	9.5438	10.2120	9.8967
V_{mstd}	Volume metered, standard (dscf)	39.2596	38.5190	37.4604	38.4130
P_s	Sample gas pressure, absolute (in. Hg)	29.9647	29.9747	29.9747	29.9714
P_v	Vapor pressure, actual (in. Hg)	6.6337	6.6197	6.5503	6.6012
B_{wo}	Moisture measured in sample (% by volume)	20.1943	19.8569	21.4212	20.4908
B_{ws}	Saturated moisture content (% by volume)	22.1384	22.0844	21.8528	22.0252
B_w	Actual water vapor in gas (% by volume)	20.1943	19.8569	21.4212	20.4908
$\sqrt{\Delta P}$	Velocity head ($\sqrt{}$in. H_2O)	0.6366	0.6071	0.5970	0.6136
M_d	MW of sample gas, dry (lb/lb-mole)	30.5880	30.8000	30.9200	30.7693
M_s	MW of sample gas, wet (lb/lb-mole)	28.0459	28.2583	28.1524	28.1522
V_s	Velocity of sample (ft/sec)	38.3636	36.4400	35.8906	36.8981
%I	Isokinetic sampling (%)	98.8136	101.5894	102.2363	100.8798
Q_a	Volumetric flow rate, actual (acfm)	305,525	290,206	285,831	293,854
Q_s	Volumetric flow rate, standard (scfm)	267,167	253,891	250,236	257,098
Q_{std}	Volumetric flow rate, dry standard (dscfm)	213,215	203,476	196,632	204,441
Q_{std7}	Volumetric flow rate, dry std@7%O_2 (dscfm)	254,631	264,958	275,851	265,147
Q_a	Volumetric flow rate, actual (acf/hr)	18,331,502	17,412,375	17,149,853	17,631,243
Q_s	Volumetric flow rate, standard (scf/hr)	16,030,034	15,233,481	15,014,157	15,425,891
Q_{std}	Volumetric flow rate, dry standard (dscf/hr)	12,792,885	12,208,585	11,797,937	12,266,469
Q_a	Volumetric flow rate, actual (m^3/hr)	519,159	493,129	485,694	499,327
Q_s	Volumetric flow rate, standard (m^3/hr)	453,980	431,421	425,210	436,870
Q_{std}	Volumetric flow rate, dry standard (dry m^3/hr)	362,302	345,754	334,125	347,394
Q_{std7}	Volumetric flow rate, dry std@7%O_2 (dry m^3/hr)	432,677	450,227	468,736	450,547
Q_s	Volumetric flow rate, normal (Nm^3/hr)	423,027	402,006	396,218	407,084
Q_{std}	Volumetric flow rate, dry normal (Nm^3/hr)	337,600	322,180	311,343	323,708
Q_{std7}	Volumetric flow rate, dry normal @7%O_2 (Nm^3/hr)	403,177	419,530	436,777	419,828

Comments:
Average includes 3 runs.

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USEPA Method 5/202 (FPM/CPM)
Emission Parameters for FPM

Run No.		4	5	6	Average
Date (2014)		Mar 19	Mar 19	Mar 19	
Start Time (approx.)		11:23	13:27	15:31	
Stop Time (approx.)		12:32	14:38	16:41	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	71	70	71	**71**
P_1	L/G	21	21	21	**21**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	4.3000	2.8000	1.4000	**2.8333**
CO_2	Carbon dioxide (dry volume %)	15.1000	16.8000	17.9000	**16.6000**
T_s	Sample temperature (°F)	144.7083	144.6250	144.2083	**144.5139**
B_w	Actual water vapor in gas (% by volume)	20.1943	19.8569	21.4212	**20.4908**
Gas Flow Rate1					
Q_a	Volumetric flow rate, actual (acfm)	276,809	286,618	274,151	**279,193**
Q_s	Volumetric flow rate, standard (scfm)	241,539	250,047	238,873	**243,486**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	188,339	194,974	186,261	**189,858**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	39.2596	38.5190	37.4604	**38.4130**
%I	Isokinetic sampling (%)	98.8136	101.5894	102.2363	**100.8798**
Laboratory Data					
m_{filter}	Matter collected on filter(s) (g)	0.01789	0.01850	0.01864	
m_s	Matter collected in solvent rinse(s) (g)	0.00224	0.00169	0.00169	
m_n	Total filterable particulate matter (g)	0.02013	0.02019	0.02033	
n_{MDL}	Number of non-detectable fractions	N/A	N/A	N/A	
DLC	Detection level classification	ADL	ADL	ADL	
Filterable Particulate Matter Results					
C_{sd}	Particulate Concentration (lb/dscf)	1.1306E-06	1.1558E-06	1.1967E-06	**1.1610E-06**
C_a	Particulate Concentration (lb/acf)	7.6925E-07	7.8622E-07	8.1303E-07	**7.8950E-07**
C_{sd}	Particulate Concentration (gr/dscf)	0.0079	0.0081	0.0084	**0.0081**
C_a	Particulate Concentration (gr/acf)	0.0054	0.0055	0.0057	**0.0055**
C_{sd}	Particulate Concentration (mg/dscm)	18.1049	18.5080	19.1630	**18.5919**
C_a	Particulate Concentration (mg/m^3 (actual,wet))	12.3185	12.5902	13.0195	**12.6427**
C_{sd}	Particulate Concentration (mg/Nm^3 dry)	19.4296	19.8622	20.5651	**19.9523**
$E_{lb/hr}$	Particulate Rate (lb/hr)	12.7761	13.5206	13.3735	**13.2234**
$E_{T/yr}$	Particulate Rate (Ton/yr)	55.9594	59.2204	58.5761	**57.9186**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.1811	0.1920	0.1891	**0.1874**

Comments:

Average includes 3 runs.

[1]Gas Flow Rate calculated using M2F and 2H test runs.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

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USEPA Method 5/202 (FPM/CPM)
Emission Parameters for CPM

Run No.		4	5	6	Average
Date (2014)		Mar 19	Mar 19	Mar 19	
Start Time (approx.)		11:23	13:27	15:31	
Stop Time (approx.)		12:32	14:38	16:41	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	71	70	71	71
P_1	L/G	21	21	21	21
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760
Gas Conditions					
O_2	Oxygen (dry volume %)	4.3000	2.8000	1.4000	2.8333
CO_2	Carbon dioxide (dry volume %)	15.1000	16.8000	17.9000	16.6000
T_s	Sample temperature (°F)	144.7083	144.6250	144.2083	144.5139
B_w	Actual water vapor in gas (% by volume)	20.1943	19.8569	21.4212	20.4908
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	276,809	286,618	274,151	279,193
Q_s	Volumetric flow rate, standard (scfm)	241,539	250,047	238,873	243,486
Q_{std}	Volumetric flow rate, dry standard (dscfm)	188,339	194,974	186,261	189,858
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	39.2596	38.5190	37.4604	38.4130
%I	Isokinetic sampling (%)	98.8136	101.5894	102.2363	100.8798
Laboratory Data					
m_{CPMi}	Total Inorganic CPM Result (g)	0.00459	0.00628	0.00405	
m_{CPMo}	Total Organic CPM Result (g)	0.00026	0.00025	0.00040	
m_{CPM}	Total CPM (g)	0.00485	0.00653	0.00446	
n_{MDL}	Number of non-detectable fractions	N/A	N/A	N/A	
DLC	Detection level classification	ADL	ADL	ADL	
Condensable Particulate Matter Results					
C_{sd}	Particulate Concentration (lb/dscf)	2.7258E-07	3.7393E-07	2.6225E-07	3.0292E-07
C_a	Particulate Concentration (lb/acf)	1.8546E-07	2.5437E-07	1.7817E-07	2.0600E-07
C_{sd}	Particulate Concentration (gr/dscf)	0.0019	0.0026	0.0018	0.0021
C_a	Particulate Concentration (gr/acf)	0.0013	0.0018	0.0012	0.0014
C_{sd}	Particulate Concentration (mg/dscm)	4.3650	5.9880	4.1996	4.8509
C_a	Particulate Concentration (mg/m³ (actual,wet))	2.9699	4.0734	2.8532	3.2988
C_{sd}	Particulate Concentration (mg/Nm³ dry)	4.6844	6.4261	4.5068	5.2058
$E_{lb/hr}$	Particulate Rate (lb/hr)	3.0803	4.3744	2.9308	3.4618
$E_{T/yr}$	Particulate Rate (Ton/yr)	13.4916	19.1599	12.8369	15.1628
E_{Hi}	Particulate Rate - Heat Input-based (lb/MMBtu)	N/A	N/A	N/A	

Comments:

Average includes 3 runs.

[1]Gas Flow Rate calculated using M2F and 2H test runs.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

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Clean Air Project No: 12461
FCCU Regenerator Stack

USEPA Method 5/202 (FPM/CPM)
Emission Parameters for CPM
Separate Inorganic and Organic Results

Run No.		4	5	6	Average
Date (2014)		Mar 19	Mar 19	Mar 19	
Start Time (approx.)		11:23	13:27	15:31	
Stop Time (approx.)		12:32	14:38	16:41	
Condensable Particulate Matter Results - Inorganic Fraction					
C_{sd}	Particulate Concentration (lb/dscf)	2.5777E-07	3.5962E-07	2.3848E-07	**2.8529E-07**
C_a	Particulate Concentration (lb/acf)	1.7538E-07	2.4463E-07	1.6203E-07	**1.9401E-07**
C_{sd}	Particulate Concentration (gr/dscf)	0.0018	0.0025	0.0017	**0.0020**
C_a	Particulate Concentration (gr/acf)	0.0012	0.0017	0.0011	**0.0014**
C_{sd}	Particulate Concentration (mg/dscm)	4.1278	5.7588	3.8190	**4.5685**
C_a	Particulate Concentration (mg/m³ (actual,wet))	2.8085	3.9175	2.5946	**3.1069**
C_{sd}	Particulate Concentration (mg/Nm³ dry)	4.4298	6.1802	4.0984	**4.9028**
$E_{lb/hr}$	Particulate Rate (lb/hr)	2.9129	4.2070	2.6652	**3.2617**
E_{RP}	Particulate Rate - Production-based (lb/Mlb Coke)	0.0413	0.0597	0.0377	**0.0462**
Condensable Particulate Matter Results - Organic Fraction					
C_{sd}	Particulate Concentration (lb/dscf)	1.4815E-08	1.4311E-08	2.3767E-08	**1.7631E-08**
C_a	Particulate Concentration (lb/acf)	1.0080E-08	9.7352E-09	1.6148E-08	**1.1988E-08**
C_{sd}	Particulate Concentration (gr/dscf)	0.0001	0.0001	0.0002	**0.0001**
C_a	Particulate Concentration (gr/acf)	0.0001	0.0001	0.0001	**0.0001**
C_{sd}	Particulate Concentration (mg/dscm)	0.2372	0.2292	0.3806	**0.2823**
C_a	Particulate Concentration (mg/m³ (actual,wet))	0.1614	0.1559	0.2586	**0.1920**
C_{sd}	Particulate Concentration (mg/Nm³ dry)	0.2546	0.2459	0.4084	**0.3030**
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.1674	0.1674	0.2656	**0.2001**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.0024	0.0024	0.0038	**0.0028**

Comments:

Average includes 3 runs.

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Stack

USEPA Method 5/202 (FPM/CPM)
Emission Parameters for Total Particulate (as PM10 & PM2.5)

Run No.		4	5	6	Average
Date (2014)		Mar 19	Mar 19	Mar 19	
Start Time (approx.)		11:23	13:27	15:31	
Stop Time (approx.)		12:32	14:38	16:41	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	71	70	71	71
P_1	L/G	21	21	21	21
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760
Gas Conditions					
O_2	Oxygen (dry volume %)	4.3000	2.8000	1.4000	2.8333
CO_2	Carbon dioxide (dry volume %)	15.1000	16.8000	17.9000	16.6000
T_s	Sample temperature (°F)	144.7083	144.6250	144.2083	144.5139
B_w	Actual water vapor in gas (% by volume)	20.1943	19.8569	21.4212	20.4908
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	276,809	286,618	274,151	279,193
Q_s	Volumetric flow rate, standard (scfm)	241,539	250,047	238,873	243,486
Q_{std}	Volumetric flow rate, dry standard (dscfm)	188,339	194,974	186,261	189,858
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	39.2596	38.5190	37.4604	38.4130
%I	Isokinetic sampling (%)	98.8136	101.5894	102.2363	100.8798
Laboratory Data					
m_n	Total filterable particulate matter (g)	0.02013	0.02019	0.02033	
m_{CPM}	Total condensable particulate matter (g)	0.00485	0.00653	0.00446	
m_{Part}	Total particulate (as pm10 & pm2.5) (g)	0.02498	0.02672	0.02479	
n_{MDL}	Number of non-detectable fractions	N/A	N/A	N/A	
DLC	Detection level classification	ADL	ADL	ADL	
Total Particulate (as PM10 & PM2.5) Results					
C_{sd}	Particulate Concentration (lb/dscf)	1.4032E-06	1.5297E-06	1.4589E-06	1.4639E-06
C_a	Particulate Concentration (lb/acf)	9.5471E-07	1.0406E-06	9.9120E-07	9.9550E-07
C_{sd}	Particulate Concentration (gr/dscf)	0.0098	0.0107	0.0102	0.0102
C_a	Particulate Concentration (gr/acf)	0.0067	0.0073	0.0069	0.0070
C_{sd}	Particulate Concentration (mg/dscm)	22.4699	24.4960	23.3625	23.4428
C_a	Particulate Concentration (mg/m^3 (actual,wet))	15.2884	16.6635	15.8727	15.9416
C_{sd}	Particulate Concentration (mg/Nm^3 dry)	24.1140	26.2884	25.0720	25.1581
$E_{lb/hr}$	Particulate Rate (lb/hr)	15.8564	17.8950	16.3043	16.6853
$E_{T/yr}$	Particulate Rate (Ton/yr)	69.4510	78.3803	71.4130	73.0814
E_{Rp}	Particulate Rate - Production-based (lb/Mlb Coke)	0.2248	0.2541	0.2305	0.2365

Comments:

Average includes 3 runs.

[1]Gas Flow Rate calculated using M2F and 2H test runs.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 8 (H2SO4)
Sampling, Velocity and Moisture Parameters

Run No.		1	2	3	Average
Date (2014)		Mar 20	Mar 20	Mar 20	
Start Time (approx.)		09:31	11:55	13:26	
Stop Time (approx.)		10:50	13:02	14:32	
Sampling Conditions					
Y_d	Dry gas meter correction factor	0.9931	0.9931	0.9931	
C_p	Pitot tube coefficient	0.8310	0.8310	0.8310	
P_g	Static pressure (in. H_2O)	0.2000	0.2000	0.2000	
A_s	Sample location area (ft^2)	132.7323	132.7323	132.7323	
P_{bar}	Barometric pressure (in. Hg)	29.96	29.96	29.96	29.9600
D_n	Nozzle diameter (in.)	0.2750	0.2750	0.2750	
O_2	Oxygen (dry volume %)	2.8000	1.9000	1.7000	2.1333
CO_2	Carbon dioxide (dry volume %)	17.1000	17.8000	18.0000	17.6333
N_2+CO	Nitrogen plus carbon monoxide (dry volume %)	80.1000	80.3000	80.3000	80.2333
V_{lc}	Total Liquid collected (ml)	211.40	222.30	202.50	
V_m	Volume metered, meter conditions (ft^3)	38.0820	39.2850	38.1800	
T_m	Dry gas meter temperature (°F)	73.4375	74.1875	79.6875	
T_s	Sample temperature (°F)	144.1667	143.7500	144.1667	144.0278
ΔH	Meter box orifice pressure drop (in. H_2O)	1.3075	1.3525	1.2971	
θ	Total sampling time (min)	60.0	60.0	60.0	
Flow Results					
V_{wstd}	Volume of water collected (ft^3)	9.9485	10.4614	9.5296	9.9799
V_{mstd}	Volume metered, standard (dscf)	37.5890	38.7263	37.2484	37.8546
P_s	Sample gas pressure, absolute (in. Hg)	29.9747	29.9747	29.9747	29.9747
P_v	Vapor pressure, actual (in. Hg)	6.5434	6.4747	6.5434	6.5205
B_{wo}	Moisture measured in sample (% by volume)	20.9277	21.2684	20.3721	20.8560
B_{ws}	Saturated moisture content (% by volume)	21.8298	21.6004	21.8298	21.7533
B_w	Actual water vapor in gas (% by volume)	20.9277	21.2684	20.3721	20.8560
$\sqrt{\Delta P}$	Velocity head ($\sqrt{}$in. H_2O)	0.5979	0.6096	0.5961	0.6012
M_d	MW of sample gas, dry (lb/lb-mole)	30.8480	30.9240	30.9480	30.9067
M_s	MW of sample gas, wet (lb/lb-mole)	28.1592	28.1753	28.3102	28.2149
V_s	Velocity of sample (ft/sec)	35.9352	36.6142	35.7349	36.0948
%I	Isokinetic sampling (%)	101.8137	103.3231	100.7485	101.9617
Q_a	Volumetric flow rate, actual (acfm)	286,186	291,593	284,591	287,456
Q_s	Volumetric flow rate, standard (scfm)	250,564	255,474	249,167	251,735
Q_{std}	Volumetric flow rate, dry standard (dscfm)	198,127	201,139	198,407	199,224
Q_{std7}	Volumetric flow rate, dry std@7%O_2 (dscfm)	257,992	274,938	274,058	268,996
Q_a	Volumetric flow rate, actual (acf/hr)	17,171,134	17,495,581	17,075,444	17,247,386
Q_s	Volumetric flow rate, standard (scf/hr)	15,033,825	15,328,458	14,950,045	15,104,109
Q_{std}	Volumetric flow rate, dry standard (dscf/hr)	11,887,598	12,068,340	11,904,412	11,953,450
Q_a	Volumetric flow rate, actual (m^3/hr)	486,297	495,485	483,587	488,456
Q_s	Volumetric flow rate, standard (m^3/hr)	425,767	434,111	423,394	427,757
Q_{std}	Volumetric flow rate, dry standard (dry m^3/hr)	336,664	341,783	337,140	338,529
Q_{std7}	Volumetric flow rate, dry std@7%O_2 (dry m^3/hr)	438,390	467,185	465,690	457,088
Q_s	Volumetric flow rate, normal (Nm^3/hr)	396,737	404,512	394,526	398,592
Q_{std}	Volumetric flow rate, dry normal (Nm^3/hr)	313,709	318,479	314,153	315,447
Q_{std7}	Volumetric flow rate, dry normal @7%O_2 (Nm^3/hr)	408,499	435,331	433,938	425,923

Comments:
Average includes 3 runs.

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 8 (H2SO4)
H2SO4 Parameters

Run No.		1	2	3	Average
Date (2014)		Mar 20	Mar 20	Mar 20	
Start Time (approx.)		09:31	11:55	13:26	
Stop Time (approx.)		10:50	13:02	14:32	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	70.3	70.2	70.3	70.3
P_1	L/G	21.8	21.8	21.9	21.8
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760
Gas Conditions					
O_2	Oxygen (dry volume %)	2.8000	1.9000	1.7000	2.1333
CO_2	Carbon dioxide (dry volume %)	17.1000	17.8000	18.0000	17.6333
T_s	Sample temperature (°F)	144.1667	143.7500	144.1667	144.0278
B_w	Actual water vapor in gas (% by volume)	20.9277	21.2684	20.3721	20.8560
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	259,000	252,000	245,000	252,000
Q_s	Volumetric flow rate, standard (scfm)	224,000	220,000	215,000	219,667
Q_{std}	Volumetric flow rate, dry standard (dscfm)	175,000	172,000	168,000	171,667
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	37.5890	38.7263	37.2484	37.8546
%I	Isokinetic sampling (%)	101.8137	103.3231	100.7485	101.9617
Laboratory Data					
m_n	Total H2SO4 collected (mg)	18.0000	14.0000	15.1000	15.7000
Sulfuric Acid Vapor (H2SO4) Results					
C_{sd}	H2SO4 Concentration (lb/dscf)	1.0559E-06	7.9713E-07	8.9388E-07	9.1564E-07
C_a	H2SO4 Concentration (lb/acf)	7.1344E-07	5.4408E-07	6.1294E-07	6.2349E-07
C_{sd}	H2SO4 Concentration (ppmdv)	5.0842	3.8383	4.3041	4.4089
C_w	H2SO4 Concentration (ppmwv)	4.0202	3.0219	3.4273	3.4898
C_{sd}	H2SO4 Concentration (mg/dscm)	16.9087	12.7650	14.3142	14.6626
C_a	H2SO4 Concentration (mg/m3 (actual,wet))	11.4248	8.7126	9.8155	9.9843
C_{sd}	H2SO4 Concentration (mg/Nm3 dry)	18.1459	13.6990	15.3616	15.7355
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	11.0869	8.2264	9.0103	9.4412
$E_{T/yr}$	H2SO4 Rate (Ton/yr)	48.5605	36.0317	39.4651	41.3524

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 8 (H2SO4)
H2SO4 Parameters

Run No.		4	5	6	Average
Date (2014)		Mar 21	Mar 21	Mar 21	
Start Time (approx.)		08:23	10:06	11:42	
Stop Time (approx.)		09:32	11:11	12:48	
Process Conditions					
R_P	Coke Burn Rate (MPPH)	69.9	70.4	70.4	70.2
P_1	L/G	18.0	18.0	18.0	18
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760
Gas Conditions					
O_2	Oxygen (dry volume %)	2.0000	2.1000	1.6000	1.9000
CO_2	Carbon dioxide (dry volume %)	17.5000	17.7000	18.0000	17.7333
T_s	Sample temperature (°F)	144.3333	144.1667	144.2500	144.2500
B_w	Actual water vapor in gas (% by volume)	20.8485	21.8662	18.8231	20.5126
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	259,000	252,000	245,000	252,000
Q_s	Volumetric flow rate, standard (scfm)	224,000	220,000	215,000	219,667
Q_{std}	Volumetric flow rate, dry standard (dscfm)	175,000	172,000	168,000	171,667
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	38.5736	39.2286	37.7693	38.5238
%I	Isokinetic sampling (%)	101.6783	106.3125	99.7466	102.5791
Laboratory Data					
m_n	Total H2SO4 collected (mg)	10.3000	11.3000	6.8800	9.4933
Sulfuric Acid Vapor (H2SO4) Results					
C_{sd}	H2SO4 Concentration (lb/dscf)	5.8878E-07	6.3516E-07	4.0166E-07	5.4187E-07
C_a	H2SO4 Concentration (lb/acf)	3.9783E-07	4.3352E-07	2.7542E-07	3.6892E-07
C_{sd}	H2SO4 Concentration (ppmdv)	2.8350	3.0584	1.9340	2.6091
C_w	H2SO4 Concentration (ppmwv)	2.2440	2.3896	1.5700	2.0679
C_{sd}	H2SO4 Concentration (mg/dscm)	9.4286	10.1712	6.4320	8.6773
C_a	H2SO4 Concentration (mg/m3 (actual,wet))	6.3706	6.9423	4.4105	5.9078
C_{sd}	H2SO4 Concentration (mg/Nm3 dry)	10.1184	10.9155	6.9027	9.3122
$E_{lb/hr}$	H2SO4 Rate (lb/hr)	6.1822	6.5549	4.0487	5.5953
$E_{T/yr}$	H2SO4 Rate (Ton/yr)	27.0782	28.7104	17.7334	24.5073

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA OTM 029 (Hydrogen Cyanide)
Sampling, Velocity and Moisture Parameters

Run No.		1*	2	3	8	Average
Date (2014)		Mar 18	Mar 18	Mar 19	Mar 21	
Start Time (approx.)		10:45	17:56	09:14	08:23	
Stop Time (approx.)		12:01	19:09	10:23	09:32	
Sampling Conditions						
Y_d	Dry gas meter correction factor	0.9884	0.9884	0.9884	0.9884	
C_p	Pitot tube coefficient	0.8320	0.8320	0.8320	0.8320	
P_g	Static pressure (in. H_2O)	0.2000	0.2000	0.2000	0.2000	
A_s	Sample location area (ft^2)	132.7323	132.7323	132.7323	132.7323	
P_{bar}	Barometric pressure (in. Hg)	29.76	29.76	29.96	29.91	29.8767
D_n	Nozzle diameter (in.)	0.2500	0.2350	0.2350	0.2350	
O_2	Oxygen (dry volume %)	2.7000	2.9000	3.7000	2.3000	2.9667
CO_{2out}	Carbon dioxide at the outlet of the sampling train (dry volume %)	13.5000	13.8000	11.7000	13.4000	12.9667
N_2+CO	Nitrogen plus carbon monoxide (dry volume %)	79.8500	79.7000	78.8000	80.2000	79.5667
CO_{2in}	Carbon dioxide in the stack (dry volume %)	17.4500	17.4000	17.5000	17.5000	17.4667
V_m	Volume metered, meter conditions (ft^3)	32.2700	29.5900	26.4950	27.1650	
T_m	Dry gas meter temperature (°F)	66.1250	76.2500	66.7708	75.2917	
T_s	Sample temperature (°F)	143.0833	143.0833	143.7500	142.9583	143.2639
ΔH	Meter box orifice pressure drop (in. H_2O)	0.8938	0.7238	0.6121	0.6225	
θ	Total sampling time (min)	60.0	60.0	60.0	60.0	
Flow Results						
V_{mstd}	Volume metered, standard (dscf)	31.8957	28.6826	26.3128	26.5052	27.1669
V_{actual}	Volume metered standard, corrected for CO_2 absorption (dscf)	33.4219	29.9326	28.1627	27.8224	28.6392
P_s	Sample gas pressure, absolute (in. Hg)	29.7747	29.7747	29.9747	29.9247	29.8914
P_v	Vapor pressure, actual (in. Hg)	6.3659	6.3659	6.4747	6.3457	6.3954
B_{wo}	Moisture measured from concurrent USEPA Method 4 test (% by volume)	24.2559	22.4543	21.5800	18.8231	20.9525
B_{ws}	Saturated moisture content from concurrent USEPA Method 4 test (% by volume)	21.9764	22.0693	21.9915	21.9124	21.9911
B_w	Actual water vapor in gas from concurrent USEPA Method 4 test (% by volume)	21.9764	22.0693	21.5800	18.8231	20.8241
$\sqrt{\Delta P}$	Velocity head ($\sqrt{}$in. H_2O)	0.6011	0.6095	0.5990	0.6042	0.6042
M_d	MW of sample gas, dry (lb/lb-mole)	30.9000	30.9000	30.9480	30.8920	30.9133
M_s	MW of sample gas, wet (lb/lb-mole)	28.0650	28.0531	28.1538	28.4653	28.2241
V_s	Velocity of sample (ft/sec)	36.3211	36.8402	36.0351	36.1547	36.3433
%I	Isokinetic sampling (%)	110.3696	110.4236	104.9642	95.1501	103.5126
Q_a	Volumetric flow rate, actual (acfm)	289,259	293,393	286,981	287,933	289,436
Q_s	Volumetric flow rate, standard (scfm)	252,017	255,619	251,434	252,178	253,077
Q_{std}	Volumetric flow rate, dry standard (dscfm)	196,632	199,205	197,174	204,710	200,363
Q_{std7}	Volumetric flow rate, dry std@7%O_2 (dscfm)	257,461	257,964	243,986	273,929	258,626
Q_a	Volumetric flow rate, actual (acf/hr)	17,355,527	17,603,588	17,218,866	17,276,009	17,366,154
Q_s	Volumetric flow rate, standard (scf/hr)	15,120,992	15,337,115	15,086,019	15,130,676	15,184,604
Q_{std}	Volumetric flow rate, dry standard (dscf/hr)	11,797,944	11,952,318	11,830,460	12,282,611	12,021,796
Q_a	Volumetric flow rate, actual (m^3/hr)	491,519	498,544	487,648	489,267	491,820
Q_s	Volumetric flow rate, standard (m^3/hr)	428,235	434,356	427,245	428,510	430,037
Q_{std}	Volumetric flow rate, dry standard (dry m^3/hr)	334,125	338,497	335,046	347,851	340,464
Q_{std7}	Volumetric flow rate, dry std@7%O_2 (dry m^3/hr)	437,487	438,341	414,589	465,469	439,466
Q_s	Volumetric flow rate, normal (Nm^3/hr)	399,038	404,741	398,115	399,293	400,716
Q_{std}	Volumetric flow rate, dry normal (Nm^3/hr)	311,344	315,417	312,202	324,134	317,251
Q_{std7}	Volumetric flow rate, dry normal @7%O_2 (Nm^3/hr)	407,658	408,454	386,321	433,733	409,503

Comments:

Average includes 3 runs. * indicates that the run is not included in the average.
CO_{2out} values obtained from concurrent USEPA Method 3A CEM testing.

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA OTM 029
HCN Parameters

Run No.		1	2	3	8	Average
Date (2014)		Mar 18	Mar 18	Mar 19	Mar 21	
Start Time (approx.)		10:45	17:56	09:14	08:23	
Stop Time (approx.)		12:01	19:09	10:23	09:32	
Process Conditions						
R_P	Coke Burn Rate (MPPH)	69.7	70.7	70.1	69.9	**70.2**
P_1	L/G	18.1	18.0	18.7	18.0	**18.2**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760	**8,760**
Gas Conditions						
O_2	Oxygen (dry volume %)	2.7000	2.9000	3.7000	2.3000	**2.9000**
CO_{2out}	Carbon dioxide at the outlet of the sampling train (dry volume %)	13.5000	13.8000	11.7000	13.4000	**13.1000**
CO_{2in}	Carbon dioxide in the stack (dry volume %)	17.4500	17.4000	17.5000	17.5000	**17.4625**
T_s	Sample temperature (°F)	143.0833	143.0833	143.7500	142.9583	**143.2188**
B_w	Actual water vapor in gas from concurrent USEPA Method 4 test (% by volume)	21.9764	22.0693	21.5800	18.8231	**21.1122**
Gas Flow Rate						
Q_a	Volumetric flow rate, actual (acfm)	267,664	264,152	272,220	265,049	**267,271**
Q_s	Volumetric flow rate, standard (scfm)	232,087	228,814	237,105	224,104	**230,527**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	180,974	178,422	184,882	174,997	**179,819**
Sampling Data						
V_{mstd}	Volume metered, standard (dscf)	31.8957	28.6826	26.3128	26.5052	**28.3491**
V_{actual}	Volume metered standard, corrected for CO_2 absorption (dscf)	33.4219	29.9326	28.1627	27.8224	**30.5057**
%I	Isokinetic sampling (%)	110.3696	110.4236	104.9642	95.1501	**105.2269**
Laboratory Data						
m_n	Total HCN collected (mg)	28.6760	29.8310	22.4100	26.9100	
Hydrogen Cyanide (HCN) Results						
C_{sd}	HCN Concentration (lb/dscf)	1.8919E-06	2.1975E-06	1.7546E-06	2.2387E-06	**2.0207E-06**
C_a	HCN Concentration (lb/acf)	1.2792E-06	1.4843E-06	1.1917E-06	1.4781E-06	**1.3583E-06**
C_{sd}	HCN Concentration (ppmdv)	26.9858	31.3452	25.0274	31.9324	**28.8227**
C_w	HCN Concentration (ppmwv)	21.0553	24.4275	19.6265	25.9217	**22.7578**
C_{sd}	HCN Concentration (mg/dscm)	30.2960	35.1901	28.0974	35.8493	**32.3582**
C_a	HCN Concentration (mg/m3 (actual,wet))	20.4839	23.7693	19.0827	23.6693	**21.7513**
C_{sd}	HCN Concentration (mg/Nm3 dry)	32.5128	37.7650	30.1533	38.4724	**34.7259**
$E_{lb/hr}$	HCN Rate (lb/hr)	20.5430	23.5251	19.4636	23.5058	**21.7594**
$E_{T/yr}$	HCN Rate (Ton/yr)	89.9784	103.0401	85.2506	102.9552	**95.3061**

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA OTM 029 (Hydrogen Cyanide)
Sampling, Velocity and Moisture Parameters

Run No.		4*	5	6	7	Average
Date (2014)		Mar 19	Mar 19	Mar 19	Mar 20	
Start Time (approx.)		11:23	13:27	15:31	09:31	
Stop Time (approx.)		12:32	14:38	16:41	11:11	
Sampling Conditions						
Y_d	Dry gas meter correction factor	0.9884	0.9884	0.9884	0.9884	
C_p	Pitot tube coefficient	0.8320	0.8320	0.8320	0.8320	
P_g	Static pressure (in. H_2O)	0.2000	0.2000	0.2000	0.2000	
A_s	Sample location area (ft^2)	132.7323	132.7323	132.7323	132.7323	
P_{bar}	Barometric pressure (in. Hg)	29.96	29.96	29.96	29.96	29.9600
D_n	Nozzle diameter (in.)	0.2350	0.2350	0.2350	0.2350	
O_2	Oxygen (dry volume %)	10.0000	2.3000	1.8000	3.6000	2.5667
CO_{2out}	Carbon dioxide at the outlet of the sampling train (dry volume %)	7.0000	12.5000	13.0000	11.3000	12.2667
N_2+CO	Nitrogen plus carbon monoxide (dry volume %)	74.9000	80.9000	80.3000	78.4000	79.8667
CO_{2in}	Carbon dioxide in the stack (dry volume %)	15.1000	16.8000	17.9000	18.0000	17.5667
V_m	Volume metered, meter conditions (ft^3)	24.8304	27.1600	27.2800	27.1400	
T_m	Dry gas meter temperature (°F)	74.3542	83.6458	86.0625	70.2083	
T_s	Sample temperature (°F)	143.6667	142.9583	142.8750	142.8750	142.9028
ΔH	Meter box orifice pressure drop (in. H_2O)	0.5921	0.6375	0.6221	0.6238	
θ	Total sampling time (min)	60.0	60.0	60.0	60.0	
Flow Results						
V_{mstd}	Volume metered, standard (dscf)	24.3085	26.1376	26.1359	26.7794	26.3510
V_{actual}	Volume metered standard, corrected for CO_2 absorption (dscf)	26.6277	27.4885	27.6958	28.9675	28.0506
P_s	Sample gas pressure, absolute (in. Hg)	29.9747	29.9747	29.9747	29.9747	29.9747
P_v	Vapor pressure, actual (in. Hg)	6.4610	6.3457	6.3323	6.3323	6.3368
B_{wo}	Moisture measured from concurrent USEPA Method 4 test (% by volume)	20.1943	19.8569	21.4212	20.3721	20.5501
B_{ws}	Saturated moisture content from concurrent USEPA Method 4 test (% by volume)	22.1384	22.0844	21.8528	21.8298	21.9223
B_w	Actual water vapor in gas from concurrent USEPA Method 4 test (% by volume)	20.1943	19.8569	21.4212	20.3721	20.5501
$\sqrt{\Delta P}$	Velocity head ($\sqrt{}$in. H_2O)	0.5886	0.6112	0.6033	0.6044	0.6063
M_d	MW of sample gas, dry (lb/lb-mole)	30.8160	30.7800	30.9360	31.0240	30.9133
M_s	MW of sample gas, wet (lb/lb-mole)	28.2279	28.2423	28.1649	28.3707	28.2593
V_s	Velocity of sample (ft/sec)	35.3610	36.6903	36.2651	36.1961	36.3838
%I	Isokinetic sampling (%)	99.3652	98.3294	102.2137	97.7155	99.4195
Q_a	Volumetric flow rate, actual (acfm)	281,613	292,199	288,813	288,263	289,758
Q_s	Volumetric flow rate, standard (scfm)	246,765	256,341	253,406	252,924	254,224
Q_{std}	Volumetric flow rate, dry standard (dscfm)	196,932	205,440	199,123	201,398	201,987
Q_{std7}	Volumetric flow rate, dry std@7%O_2 (dscfm)	154,429	274,905	273,615	250,661	266,394
Q_a	Volumetric flow rate, actual (acf/hr)	16,896,778	17,531,943	17,328,790	17,295,795	17,385,509
Q_s	Volumetric flow rate, standard (scf/hr)	14,805,871	15,380,485	15,204,363	15,175,413	15,253,420
Q_{std}	Volumetric flow rate, dry standard (dscf/hr)	11,815,933	12,326,398	11,947,399	12,083,867	12,119,221
Q_a	Volumetric flow rate, actual (m^3/hr)	478,527	496,515	490,762	489,827	492,368
Q_s	Volumetric flow rate, standard (m^3/hr)	419,311	435,584	430,597	429,777	431,986
Q_{std}	Volumetric flow rate, dry standard (dry m^3/hr)	334,634	349,091	338,357	342,222	343,223
Q_{std7}	Volumetric flow rate, dry std@7%O_2 (dry m^3/hr)	262,411	467,129	464,937	425,931	452,666
Q_s	Volumetric flow rate, normal (Nm^3/hr)	390,722	405,885	401,238	400,474	402,532
Q_{std}	Volumetric flow rate, dry normal (Nm^3/hr)	311,818	325,289	315,288	318,889	319,822
Q_{std7}	Volumetric flow rate, dry normal @7%O_2 (Nm^3/hr)	244,519	435,279	433,237	396,891	421,802

Comments:

Average includes 3 runs. * indicates that the run is not included in the average.
CO_{2out} values obtained from concurrent USEPA Method 3A CEM testing.

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA OTM 029
HCN Parameters

Run No.		4	5	6	7	Average
Date (2014)		Mar 19	Mar 19	Mar 19	Mar 20	
Start Time (approx.)		11:23	13:27	15:31	09:31	
Stop Time (approx.)		12:32	14:38	16:41	11:11	
Process Conditions						
R_P	Coke Burn Rate (MPPH)	70.5	70.4	70.7	70.3	70.5
P_1	L/G	20.8	20.8	20.8	21.8	21.1
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760	8,760
Gas Conditions						
O_2	Oxygen (dry volume %)	10.0000	2.3000	1.8000	3.6000	2.5667
CO_{2out}	Carbon dioxide at the outlet of the sampling train (dry volume %)	7.0000	12.5000	13.0000	11.3000	12.2667
CO_{2in}	Carbon dioxide in the stack (dry volume %)	15.1000	16.8000	17.9000	18.0000	17.5667
T_s	Sample temperature (°F)	143.6667	142.9583	142.8750	142.8750	142.9028
B_w	Actual water vapor in gas from *concurrent* USEPA Method 4 test (% by volume)	20.1943	19.8569	21.4212	20.3721	20.5501
Gas Flow Rate						
Q_a	Volumetric flow rate, actual (acfm)	276,809	286,618	274,151	258,625	273,131
Q_s	Volumetric flow rate, standard (scfm)	241,539	250,047	238,873	223,553	237,491
Q_{std}	Volumetric flow rate, dry standard (dscfm)	188,339	194,974	186,261	174,923	185,386
Sampling Data						
V_{mstd}	Volume metered, standard (dscf)	24.3085	26.1376	26.1359	26.7794	26.3510
V_{actual}	Volume metered standard, corrected for CO_2 absorption (dscf)	26.6277	27.4885	27.6958	28.9675	28.0506
%I	Isokinetic sampling (%)	99.3652	98.3294	102.2137	97.7155	99.4195
Laboratory Data						
m_n	Total HCN collected (mg)	17.3330	20.0720	19.9030	18.8880	19.6210
Hydrogen Cyanide (HCN) Results						
C_{sd}	HCN Concentration (lb/dscf)	1.4353E-06	1.6101E-06	1.5846E-06	1.5552E-06	1.5833E-06
C_a	HCN Concentration (lb/acf)	9.7658E-07	1.0953E-06	1.0766E-06	1.0519E-06	1.0746E-06
C_{sd}	HCN Concentration (ppmdv)	20.4733	22.9662	22.6023	22.1837	22.5841
C_w	HCN Concentration (ppmwv)	16.3389	18.4058	17.7606	17.6644	17.9436
C_{sd}	HCN Concentration (mg/dscm)	22.9847	25.7833	25.3748	24.9048	25.3543
C_a	HCN Concentration (mg/m3 (actual,wet))	15.6386	17.5392	17.2399	16.8446	17.2079
C_{sd}	HCN Concentration (mg/Nm3 dry)	24.6665	27.6698	27.2315	26.7271	27.2095
$E_{lb/hr}$	HCN Rate (lb/hr)	16.2196	18.8354	17.7087	16.3227	17.6223
$E_{T/yr}$	HCN Rate (Ton/yr)	71.0420	82.4992	77.5639	71.4935	77.1855

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Marathon
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FCCU

Continuous Emissions Monitoring Parameters

Run Number	1		
Date (2014)	Mar 20		
Start Time	9:07		
End Time	10:17		
Elapsed Time (hh:mm)	01:10		
Channel	1	2	3
Parameter	O2	CO2	THC
Location	FCCU	FCCU	FCCU
Measurement Units	%dv	%dv	ppmwv
Measured Average (drift-corrected)	1.26	18.77	3.56
Concentration (ppmwv)			3.56
Concentration (lb/dscf)			4.069E-07
Concentration (lb/scf)			3.184E-07
Concentration (lb/acf)			2.752E-07
Concentration (%dv)	1.256	18.771	0.000
Concentration (%wv)	1.256	18.771	0.000
Concentration (mg/dscm)			6.52
Concentration (mg/scm)			5.10
Concentration (mg/acm)			4.41
Concentration (mg/Nm3)			6.99
Mass Rate (lb/hr)			4.27
Mass Rate (kg/hr)			1.94
Mass Rate (gm/sec)			0.54
Mass Rate (Ton/yr)			18.70
Mass Rate (lb/Mlb Coke)			N/A

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Marathon
Clean Air Project No. 12461
Garyville, LA
FCCU

Continuous Emissions Monitoring Parameters

Run Number	2		
Date (2014)	Mar 20		
Start Time	13:07		
End Time	14:09		
Elapsed Time (hh:mm)	01:02		
Channel	1	2	3
Parameter	O2	CO2	THC
Location	FCCU	FCCU	FCCU
Measurement Units	%dv	%dv	ppmwv
Measured Average (drift-corrected)	1.18	18.83	3.11
Concentration (ppmwv)			3.11
Concentration (lb/dscf)			3.554E-07
Concentration (lb/scf)			2.781E-07
Concentration (lb/acf)			2.431E-07
Concentration (%dv)	1.176	18.831	0.000
Concentration (%wv)	1.176	18.831	0.000
Concentration (mg/dscm)			5.69
Concentration (mg/scm)			4.45
Concentration (mg/acm)			3.89
Concentration (mg/Nm3)			6.11
Mass Rate (lb/hr)			3.58
Mass Rate (kg/hr)			1.62
Mass Rate (gm/sec)			0.45
Mass Rate (Ton/yr)			15.68
Mass Rate (lb/Mlb Coke)			N/A

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Marathon
Clean Air Project No. 12461
Garyville, LA
FCCU

Continuous Emissions Monitoring Parameters

Run Number	3		
Date (2014)	Mar 20		
Start Time	14:20		
End Time	15:22		
Elapsed Time (hh:mm)	01:02		
Channel	1	2	3
Parameter	O2	CO2	THC
Location	FCCU	FCCU	FCCU
Measurement Units	%dv	%dv	ppmwv
Measured Average (drift-corrected)	1.13	18.87	2.64
Concentration (ppmwv)			2.64
Concentration (lb/dscf)			3.018E-07
Concentration (lb/scf)			2.361E-07
Concentration (lb/acf)			2.062E-07
Concentration (%dv)	1.131	18.871	0.000
Concentration (%wv)	1.131	18.871	0.000
Concentration (mg/dscm)			4.83
Concentration (mg/scm)			3.78
Concentration (mg/acm)			3.30
Concentration (mg/Nm3)			5.19
Mass Rate (lb/hr)			2.99
Mass Rate (kg/hr)			1.35
Mass Rate (gm/sec)			0.38
Mass Rate (Ton/yr)			13.09
Mass Rate (lb/Mlb Coke)			N/A

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Marathon
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Garyville, LA
FCCU Regenerator

Continuous Emissions Monitoring Parameters

Run Number	4		
Date (2014)	Mar 21		
Start Time	8:34		
End Time	9:54		
Elapsed Time (hh:mm)	01:20		
Channel	1	2	3
Parameter	O2	CO2	THC
Location	CCU Regenerat	CU Regenera	CU Regenera
Measurement Units	%dv	%dv	ppmwv
Measured Average (drift-corrected)	3.26	16.85	2.49
Concentration (ppmdv)			2.49
Concentration (ppmwv)			2.49
Concentration (lb/dscf)			2.850E-07
Concentration (lb/scf)			2.225E-07
Concentration (lb/acf)			1.882E-07
Concentration (%dv)	3.255	16.848	0.000
Concentration (%wv)	3.255	16.848	0.000
Concentration (mg/dscm)			4.56
Concentration (mg/scm)			3.56
Concentration (mg/acm)			3.01
Concentration (mg/Nm3)			4.90
Mass Rate (lb/hr)			2.99
Mass Rate (kg/hr)			1.36
Mass Rate (gm/sec)			0.38
Mass Rate (Ton/yr)			13.11
Mass Rate (lb/Mlb Coke)			N/A

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Marathon
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Garyville, LA
FCCU Regenerator

Continuous Emissions Monitoring Parameters

Run Number	5		
Date (2014)	Mar 21		
Start Time	10:30		
End Time	11:40		
Elapsed Time (hh:mm)	01:10		
Channel	1	2	3
Parameter	O2	CO2	THC
Location	CCU Regenerat	CU Regener	CU Regener
Measurement Units	%dv	%dv	ppmwv
Measured Average (drift-corrected)	1.11	18.91	2.44
Concentration (ppmdv)			2.44
Concentration (ppmwv)			2.44
Concentration (lb/dscf)			2.791E-07
Concentration (lb/scf)			2.179E-07
Concentration (lb/acf)			1.850E-07
Concentration (%dv)	1.107	18.911	0.000
Concentration (%wv)	1.107	18.911	0.000
Concentration (mg/dscm)			4.47
Concentration (mg/scm)			3.49
Concentration (mg/acm)			2.96
Concentration (mg/Nm3)			4.80
Mass Rate (lb/hr)			3.06
Mass Rate (kg/hr)			1.39
Mass Rate (gm/sec)			0.39
Mass Rate (Ton/yr)			13.40
Mass Rate (lb/Mlb Coke)			N/A

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Marathon
Clean Air Project No. 12461
Garyville, LA
FCCU Regenerator

Continuous Emissions Monitoring Parameters

Run Number	6		
Date (2014)	Mar 21		
Start Time	12:51		
End Time	13:52		
Elapsed Time (hh:mm)	01:01		
Channel	1	2	3
Parameter	O2	CO2	THC
Location	CCU Regenerat	CU Regenera	CU Regenera
Measurement Units	%dv	%dv	ppmwv
Measured Average (drift-corrected)	0.88	19.13	2.10
Concentration (ppmdv)			2.10
Concentration (ppmwv)			2.10
Concentration (lb/dscf)			2.408E-07
Concentration (lb/scf)			1.880E-07
Concentration (lb/acf)			1.633E-07
Concentration (%dv)	0.880	19.128	0.000
Concentration (%wv)	0.880	19.128	0.000
Concentration (mg/dscm)			3.86
Concentration (mg/scm)			3.01
Concentration (mg/acm)			2.61
Concentration (mg/Nm3)			4.14
Mass Rate (lb/hr)			2.60
Mass Rate (kg/hr)			1.18
Mass Rate (gm/sec)			0.33
Mass Rate (Ton/yr)			11.37
Mass Rate (lb/Mlb Coke)			N/A

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Marathon
Clean Air Project No. 12461
Garyville, LA
FCCU Regenerator

Continuous Emissions Monitoring Parameters

Run Number	7		
Date (2014)	Mar 21		
Start Time	14:08		
End Time	15:11		
Elapsed Time (hh:mm)	01:03		
Channel	1	2	3
Parameter	O2	CO2	THC
Location	CCU Regenerati	CU Regenera	CU Regenera
Measurement Units	%dv	%dv	ppmwv
Measured Average (drift-corrected)	0.95	19.10	0.99
Concentration (ppmdv)			0.99
Concentration (ppmwv)			0.99
Concentration (lb/dscf)			1.138E-07
Concentration (lb/scf)			8.890E-08
Concentration (lb/acf)			7.560E-08
Concentration (%dv)	0.953	19.105	0.000
Concentration (%wv)	0.953	19.105	0.000
Concentration (mg/dscm)			1.82
Concentration (mg/scm)			1.42
Concentration (mg/acm)			1.21
Concentration (mg/Nm3)			1.96
Mass Rate (lb/hr)			1.23
Mass Rate (kg/hr)			0.56
Mass Rate (gm/sec)			0.16
Mass Rate (Ton/yr)			5.41
Mass Rate (lb/UNITS)			N/A

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QA/QC DATA

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I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: PNK

Date: PNK 05/14

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 5/202 (Particulate/CPM)
QA/QC Results

	Run No.	1	2*	3	
	Date (2014)	Mar 18	Mar 18	Mar 19	
	Start Time (approx.)	10:45	17:56	09:14	
	Stop Time (approx.)	12:01	19:09	10:23	
	Total Duration of Test Run (min.)	76	73	69	
	Net Sampling Time (min.)	60	60	60	
	Sampling System Calibration Summary				
	Nozzle ID No:	276-1	275-1	275-1	
D_n	Nozzle Diameter (in):	0.276	0.275	0.275	
	Probe ID No:	67-6-1	67-6-1	67-6-1	
C_p	Pitot Coefficient:	0.8310	0.8310	0.8310	
	Meter Box ID. No:	66-24	66-24	66-24	
Y_d	Meter Box Yd - Field Sheet	0.9931	0.9931	0.9931	
	Meter Box Yd - Database	0.9931	0.9931	0.9931	
	Meter Box ΔH@ - Field Sheet	1.7476	1.7476	1.7476	
	Meter Box ΔH@ - Database	1.7476	1.7476	1.7476	
	QA/QC				
	Final Leak Check				
	(a) 4% of Sampling Rate (cfm)	0.0249	0.0260	0.0258	
	(b) Allowable Rate from Method (cfm)	0.0200	0.0200	0.0200	
	Allowable Limit - minimum of a and b (cfm)	0.0200	0.0200	0.0200	
	Actual Final Leak Rate (cfm)	0.0010	0.0010	0.0010	
	Sample Volume				
	Minimum Volume Required (dscf)	30.00	30.00	30.00	
V_{mstd}	Actual Sample Volume (dscf)	36.812	38.046	38.495	
	Alternative Method 5 Post-Test Calibration (EPA ALT-009)				
$\sqrt{\Delta H_{avg}}$	Average of Square Root of ΔH (in. W.C.)	1.1644	1.1439	1.1521	
Y_{qa}	Alternative Meter Calibration Factor	1.0308	0.9753	0.9806	Average
	Variation from full-test Y_d (average ≤ ±5%)	3.8%	-1.8%	-1.3%	0.2%
	Mean Isokinetic Sampling Rate Variation				
	Minimum Allowable (%)	90	90	90	
	Maximum Allowable (%)	110	110	110	
%I	Actual Variation (%)	98.90	104.05	103.58	
	Point-by-Point Isokinetic Variation				
	Number of points <90%	2	2	0	
	Number of points >110%	0	2	3	
	Number of points <80%	0	0	0	
	Number of points >120%	0	2	1	

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Stack

USEPA Method 5/202 (Particulate/CPM)
QA/QC Results

Run No.		4	5	6	
Date (2014)		Mar 19	Mar 19	Mar 19	
Start Time (approx.)		11:23	13:27	15:31	
Stop Time (approx.)		12:32	14:38	16:41	
Total Duration of Test Run (min.)		69	71	70	
Net Sampling Time (min.)		60	60	60	
Sampling System Calibration Summary					
	Nozzle ID No:	275-1	275-1	275-1	
D_n	Nozzle Diameter (in):	0.275	0.275	0.275	
	Probe ID No:	67-6-1	67-6-1	67-6-1	
C_p	Pitot Coefficient:	0.8310	0.8310	0.8310	
	Meter Box ID. No:	66-24	66-24	66-24	
Y_d	Meter Box Yd - Field Sheet	0.9931	0.9931	0.9931	
	Meter Box Yd - Database	0.9931	0.9931	0.9931	
	Meter Box ΔH@ - Field Sheet	1.7476	1.7476	1.7476	
	Meter Box ΔH@ - Database	1.7476	1.7476	1.7476	
QA/QC					
	Final Leak Check				
	(a) 4% of Sampling Rate (cfm)	0.0268	0.0264	0.0259	
	(b) Allowable Rate from Method (cfm)	0.0200	0.0200	0.0200	
	Allowable Limit - minimum of a and b (cfm)	0.0200	0.0200	0.0200	
	Actual Final Leak Rate (cfm)	0.0010	0.0010	0.0010	
	Sample Volume				
	Minimum Volume Required (dscf)	30.00	30.00	30.00	
V_{mstd}	Actual Sample Volume (dscf)	39.260	38.519	37.460	
	Alternative Method 5 Post-Test Calibration (EPA ALT-009)				
$\sqrt{\Delta H_{avg}}$	Average of Square Root of ΔH (in. W.C.)	1.1698	1.1561	1.1365	
Y_{qa}	Alternative Meter Calibration Factor	0.9720	1.0009	0.9775	Average
	Variation from full-test Y_d (average ≤ ±5%)	-2.1%	0.8%	-1.6%	-1.0%
	Mean Isokinetic Sampling Rate Variation				
	Minimum Allowable (%)	90	90	90	
	Maximum Allowable (%)	110	110	110	
%I	Actual Variation (%)	98.81	99.14	102.24	
	Point-by-Point Isokinetic Variation				
	Number of points <90%	2	0	0	
	Number of points >110%	2	1	0	
	Number of points <80%	1	0	0	
	Number of points >120%	1	0	0	

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PNO

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 8 (H_2SO_4)
QA/QC Results

Run No.		1	2	3	
Date (2014)		Mar 20	Mar 20	Mar 20	
Start Time (approx.)		09:31	11:55	13:26	
Stop Time (approx.)		10:50	13:02	14:32	
Total Duration of Test Run (min.)		79	67	66	
Net Sampling Time (min.)		60	60	60	
Sampling System Calibration Summary					
	Nozzle ID No:	275-1	275-1	275-1	
D_n	Nozzle Diameter (in):	0.275	0.275	0.275	
	Probe ID No:	67-6-1	67-6-1	67-6-1	
C_p	Pitot Coefficient:	0.8310	0.8310	0.8310	
	Meter Box ID. No:	66-24	66-24	66-24	
Y_d	Meter Box Yd - Field Sheet	0.9931	0.9931	0.9931	
	Meter Box Yd - Database	0.9931	0.9931	0.9931	
	Meter Box ΔH@ - Field Sheet	1.7476	1.7476	1.7476	
	Meter Box ΔH@ - Database	1.7476	1.7476	1.7476	
QA/QC					
	Final Leak Check				
	(a) 4% of Sampling Rate (cfm)	0.0254	0.0262	0.0255	
	(b) Allowable Rate from Method (cfm)	0.0200	0.0200	0.0200	
	Allowable Limit - minimum of a and b (cfm)	0.0200	0.0200	0.0200	
	Actual Final Leak Rate (cfm)	0.0020	0.0020	0.0000	
	Sample Volume				
	Minimum Volume Required (dscf)	30.00	30.00	30.00	
V_{mstd}	Actual Sample Volume (dscf)	37.589	38.726	37.248	
	Alternative Method 5 Post-Test Calibration (EPA ALT-009)				
$\sqrt{\Delta H_{avg}}$	Average of Square Root of ΔH (in. W.C.)	1.1388	1.1609	1.1355	
Y_{qa}	Alternative Meter Calibration Factor	0.9895	0.9772	0.9883	Average
	Variation from full-test Y_d (average ≤ ±5%)	-0.4%	-1.6%	-0.5%	-0.8%
	Mean Isokinetic Sampling Rate Variation				
	Minimum Allowable (%)	90	90	90	
	Maximum Allowable (%)	110	110	110	
%I	Actual Variation (%)	101.81	103.32	100.75	
	Point-by-Point Isokinetic Variation				
	Number of points <90%	0	1	2	
	Number of points >110%	1	3	2	
	Number of points <80%	0	0	0	
	Number of points >120%	0	1	1	

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PLN@

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 8 (H_2SO_4)
QA/QC Results

Run No.		4	5	6	
	Date (2014)	Mar 21	Mar 21	Mar 21	
	Start Time (approx.)	08:23	10:06	11:42	
	Stop Time (approx.)	09:32	11:11	12:48	
	Total Duration of Test Run (min.)	69	65	66	
	Net Sampling Time (min.)	60	60	60	
Sampling System Calibration Summary					
	Nozzle ID No:	275-1	275-1	275-1	
D_n	Nozzle Diameter (in):	0.275	0.275	0.275	
	Probe ID No:	67-6-1	67-6-1	67-6-1	
C_p	Pitot Coefficient:	0.8310	0.8310	0.8310	
	Meter Box ID. No:	66-24	66-24	66-24	
Y_d	Meter Box Yd - Field Sheet	0.9931	0.9931	0.9931	
	Meter Box Yd - Database	0.9931	0.9931	0.9931	
	Meter Box ΔH@ - Field Sheet	1.7476	1.7476	1.7476	
	Meter Box ΔH@ - Database	1.7476	1.7476	1.7476	
QA/QC					
	Final Leak Check				
	(a) 4% of Sampling Rate (cfm)	0.0265	0.0272	0.0261	
	(b) Allowable Rate from Method (cfm)	0.0200	0.0200	0.0200	
	Allowable Limit - minimum of a and b (cfm)	0.0200	0.0200	0.0200	
	Actual Final Leak Rate (cfm)	0.0010	0.0080	0.0020	
	Sample Volume				
	Minimum Volume Required (dscf)	30.00	30.00	30.00	
V_{mstd}	Actual Sample Volume (dscf)	38.574	39.229	37.769	
	Alternative Method 5 Post-Test Calibration (EPA ALT-009)				
$\sqrt{\Delta H_{avg}}$	Average of Square Root of ΔH (in. W.C.)	1.1707	1.1517	1.1461	
Y_{qa}	Alternative Meter Calibration Factor	0.9820	0.9462	0.9784	Average
	Variation from full-test Y_d (average ≤ ±5%)	-1.1%	-4.7%	-1.5%	-2.4%
	Mean Isokinetic Sampling Rate Variation				
	Minimum Allowable (%)	90	90	90	
	Maximum Allowable (%)	110	110	110	
%I	Actual Variation (%)	101.68	106.31	99.75	
	Point-by-Point Isokinetic Variation				
	Number of points <90%	2	0	0	
	Number of points >110%	2	2	0	
	Number of points <80%	2	0	0	
	Number of points >120%	2	1	0	

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA OTM 029 (Hydrogen Cyanide)
QA/QC Results

	Run No.	1*	2	3	8
	Date (2014)	Mar 18	Mar 18	Mar 19	Mar 21
	Start Time (approx.)	10:45	17:56	09:14	08:23
	Stop Time (approx.)	12:01	19:09	10:23	09:32
	Total Duration of Test Run (min.)	76	73	69	69
	Net Sampling Time (min.)	60	60	60	60
	Sampling System Calibration Summary				
	Nozzle ID No:	250-1	235-1	235-1	235-1
D_n	Nozzle Diameter (in):	0.250	0.235	0.235	0.235
	Probe ID No:	67M5-6-10	67M5-6-10	67M5-6-10	67M5-6-10
C_p	Pitot Coefficient:	0.8320	0.8320	0.8320	0.832
	Meter Box ID. No:	66-21	66-21	66-21	66-21
Y_d	Meter Box Yd - Field Sheet	0.9884	0.9884	0.9884	0.9884
	Meter Box Yd - Database	0.9884	0.9884	0.9884	0.9884
	Meter Box ΔH@ - Field Sheet	1.7537	1.7537	1.7537	1.7537
	Meter Box ΔH@ - Database	1.7537	1.7537	1.7537	1.7537
	QA/QC				
	Final Leak Check				
	(a) 4% of Sampling Rate (cfm)	0.0215	0.0197	0.0177	0.0181
	(b) Allowable Rate from Method (cfm)	0.0200	0.0200	0.0200	0.0200
	Allowable Limit - minimum of a and b (cfm)	0.0200	0.0197	0.0177	0.0181
	Actual Final Leak Rate (cfm)	0.0020	0.0010	0.0040	0.0010
	Sample Volume				
	Minimum Volume Required (dscf)	25.00	25.00	25.00	25.00
V_{mstd}	Actual Sample Volume (dscf)	31.896	28.683	26.313	26.505
	Mean Isokinetic Sampling Rate Variation				
	Minimum Allowable (%)	90	90	90	90
	Maximum Allowable (%)	110	110	110	110
%I	Actual Variation (%)	***110.37***	***110.42***	104.96	95.15
	Point-by-Point Isokinetic Variation				
	Number of points <90%	1	0	0	1
	Number of points >110%	5	3	0	0
	Number of points <80%	0	0	0	0
	Number of points >120%	1	0	0	0

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QKMN

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA OTM 029 (Hydrogen Cyanide)
QA/QC Results

Run No.		4*	5	6	7
	Date (2014)	Mar 19	Mar 19	Mar 19	Mar 20
	Start Time (approx.)	11:23	13:27	15:31	09:31
	Stop Time (approx.)	12:32	14:38	16:41	11:11
	Total Duration of Test Run (min.)	69	71	70	100
	Net Sampling Time (min.)	60	60	60	60
	Sampling System Calibration Summary				
	Nozzle ID No:	235-1	235-1	235-1	235-1
D_n	Nozzle Diameter (in):	0.235	0.235	0.235	0.235
	Probe ID No:	67M5-6-10	67M5-6-10	67M5-6-10	67M5-6-10
C_p	Pitot Coefficient:	0.8320	0.8320	0.8320	0.832
	Meter Box ID. No:	66-21	66-21	66-21	66-21
Y_d	Meter Box Yd - Field Sheet	0.9884	0.9884	0.9884	0.9884
	Meter Box Yd - Database	0.9884	0.9884	0.9884	0.9884
	Meter Box ΔH@ - Field Sheet	1.7537	1.7537	1.7537	1.7537
	Meter Box ΔH@ - Database	1.7537	1.7537	1.7537	1.7537
	QA/QC				
	Final Leak Check				
	(a) 4% of Sampling Rate (cfm)	0.0178	0.0181	0.0182	0.0181
	(b) Allowable Rate from Method (cfm)	0.0200	0.0200	0.0200	0.0200
	Allowable Limit - minimum of a and b (cfm)	0.0178	0.0181	0.0182	0.0181
	Actual Final Leak Rate (cfm)	***0.0500***	0.0030	0.0010	0.0010
	Sample Volume				
	Minimum Volume Required (dscf)	25.00	25.00	25.00	25.00
V_{mstd}	Actual Sample Volume (dscf)	***24.309***	26.138	26.136	26.779
	Mean Isokinetic Sampling Rate Variation				
	Minimum Allowable (%)	90	90	90	90
	Maximum Allowable (%)	110	110	110	110
%I	Actual Variation (%)	99.37	98.33	102.21	97.72
	Point-by-Point Isokinetic Variation				
	Number of points <90%	0	2	0	1
	Number of points >110%	0	0	0	1
	Number of points <80%	0	0	0	0
	Number of points >120%	0	0	0	0

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LMKR

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Clean Air Engineering - Meter Box Full Test Calibration

Client: Source | **Reviewed By:** R.Redel | **Calibration Signature:**

Asset#: 66-21 | **Calibrated By:** O.Lavrov | **Meter Box Yd:** 0.9884

Dept No: 66 | **Date of Calibration:** 08/20/13 | **Meter Box ΔH@:** 1.7537

Meter Box Serial No: 0028-080307-1 | **Due Date of Calibration:** 08/20/14 | **Barometer Serial No:** W12637

Manufacturer Part No: 0028 | **Meter Box Vacuum:** 1.0 in. H_2O | **Barometric Pressure:** 29.32 in. Hg

				Standard Meter Gas Volume (ft^3)			Meter Box Gas Volume (ft^3)			Std. Meter Temperature (°F)			Meter Box Temperature (°F)			Time (min.)	Calibration Results	
Q	ΔH	ΔP	Y_{ds}	Initial	Final	V_{ds} Net	Initial	Final	V_d Net	T_{is} In	T_{os} Out	T_{ds} Avg.	T_i In	T_o Out	T_d Avg.	Θ	Y_d	ΔH@
0.389	0.50	-1.20	1.0000	0.000	5.000	5.000	164.015	169.143	5.128	76.0	76.0	76.00	88.0	85.0	86.50	12.41	0.9899	1.7666
0.389	0.50	-1.20	1.0000	0.000	5.000	5.000	169.143	174.271	5.128	76.0	76.0	76.00	87.0	85.0	86.00	12.41	0.9890	1.7666
0.670	1.50	-1.40	1.0000	0.000	10.000	10.000	178.444	188.728	10.284	76.0	76.0	76.00	91.0	85.0	88.00	14.41	0.9870	1.7864
0.673	1.50	-1.40	1.0000	0.000	10.000	10.000	188.728	199.019	10.291	76.0	76.0	76.00	92.0	86.0	89.00	14.34	0.9881	1.7658
0.967	3.00	-1.80	1.0000	0.000	10.000	10.000	139.910	150.115	10.205	76.0	76.0	76.00	92.0	82.0	87.00	9.98	0.9881	1.7232
0.968	3.00	-1.80	1.0000	0.000	10.000	10.000	150.115	160.342	10.227	76.0	76.0	76.00	93.0	84.0	88.50	9.97	0.9887	1.7134
																Averages	0.98844	1.75368

Nomenclature

P_b	Barometric Pressure (in. Hg)
Q	Flow Rate (cfm)
ΔH	Orifice Pressure differential (in. H_2O)
ΔP	Inlet Pressure Differential (in. H_2O)
V_d	Gas Meter Volume - Dry (ft^3)
V_{ds}	Standard Meter Volume - Dry (ft^3)
T_d	Average Meter Box Temperature (°F)
T_o	Outlet Meter Box Temperature (°F)
T_{ds}	Average Standard Meter Temperature (°F)
Y_d	Meter Correction Factor (unitless), $Y_i \leq Y_{avg} \pm 0.02$
Y_{ds}	Standard Meter Correction Factor (unitless)
ΔH@	Orifice Pressure Differential giving 0.75 cfm of air at 68°F and 29.92 in. Hg (in. H_2O) $\Delta H@_i \leq \Delta H@_{avg} \pm 0.2$
Θ	Duration of Run (minutes)

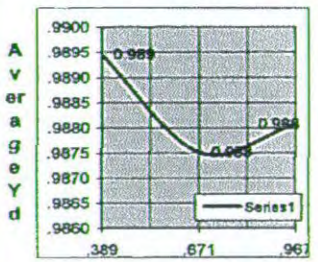
Equations

$$Y_d = (Y_{ds})\left[\frac{V_{ds}}{V_d}\right]\left[\frac{T_d + 460}{T_{ds} + 460}\right]\left[\frac{P_b + \Delta P/13.6}{P_b + \Delta H/13.6}\right]$$

$$\Delta H@ = \frac{(0.0319)(\Delta H)}{P_b(T_o + 460)}\left[\frac{(T_{ds} + 460)\Theta}{(V_{ds})(Y_{ds})}\right]^2$$

$$Q = \frac{17.64(V_{ds})(P_b)}{(T_{ds} + 460)(\Theta)}$$

Average YD vs. Average CFM



Vacuum Gauge

Standard (in Hg)	Gauge (in Hg)
5.1	5.0
10.0	10.0
14.8	15.0
19.4	20.0
24.3	25.0

Calibration Reference Information (Standard Meter)

Reference Used: Wet Test Meter | Serial No: 11AH6

Calibrated By: Martin Vaquero | Date Calibrated: 12/23/2012

Percent Error: 0.145% | Calibration Due Date: 12/23/2013

Meter Box Pre-Calibration Inspection

Positive Leak Check:	Pass	Electrical Check:	Pass
Negative Leak Check:	Pass	Pyrometer Check	Pass
Vacuum Gauge Check	Pass	YD Tolerance: ± 2% of 1.0000	Pass

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Meter Box - Pyrometer Calibration Sheet

Meter Box No: 0028-080307-1

Office: Express

Calibrated by: O.Lavrov

Client: Source

Date: 8/20/13

Job No: N/A

Temperature Scale Used: Fahrenheit

Type of Calibration: Full-Test

Calibration Reference Settings (°F)	Pyrometer Reading for each Channel (°F)						
	1 Stack	2 Probe	3 Filter	4 Imp Out	5 Aux		
50	50	52	51	50	50		
100	100	102	101	100	100		
150	150	152	150	150	150		
200	200	202	201	200	200		
250	250	252	251	250	250		
300	300	302	301	300	300		
350	350	352	351	350	350		
400	400	402	401	400	400		
450	450	452	451	450	450		
500	500	502	501	500	500		
550	550	552	551	550	550		
600	600	602	601	600	600		

Tolerance = ±2°F difference from reference setting.

Calibration Reference Information

Reference Used: Omega CL23A

Serial No: T-225950

Calibrated By: JH Metrology

Date Calibrated: 10/18/2012

Calibration Report No: 1000164938

Calibration Due Date: 10/18/2013

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Meter Box Critical Orifice Post-Test Calibration Data

Project No. 12461 Meter No. 66-21 Orifice 55-2

Location Houston Lab Meter Yd 0.9884 Orifice K' 0.4659

Test Date 03/31/14 Meter ΔH@ 1.7537 Orifice Cal. Date 04/09/13

Operator Isauro Lopez Full Test Cal. Date 08/20/13

Barom. Press. (P_b) 29.93 in. Hg

Leak Checks

Negative Pressure

No movement of manometer in one-minute ☑ Pass

Positive Pressure

No movement of manometer in one-minute ☑ Pass

Important: All leak checks must pass in order for calibration to be valid.

Run	Elapsed Time (minutes)	Meter Volume (dcf)	Meter Temperature		Ambient Temp. - T_{amb} (°F)	Orifice ΔH (in. W.C.)	Vacuum (in. Hg)	Net Run Time - Θ (minutes)	Net Meter Volume for Run - V_m (dcf)	Avg Meter Temp. for Run - T_m (°F)	DGM Calibration Factor - Y_i	Percent Variation - ΔY_i
			Inlet (°F)	Outlet (°F)								
	0.0	381.50	72	70								
	5.0	384.56	72	70	74	1.10	21	5.0	3.06	71.0	0.9890	-0.2%
	10.0	387.62	72	70	73	1.10	21	5.0	3.06	71.0	0.9899	-0.1%
	15.0	390.67	73	71	73	1.10	21	5.0	3.05	71.5	0.9941	0.3%
										Average Y_i	0.9910	
										Cal. Error	0.3%	

Calculations and Specifications

$$Y_i = \frac{K' \times P_b \times (T_m + 460) \times \theta}{17.64 \times V_m \times \left(P_b + {}^{\Delta H}/_{13.6}\right) \times \sqrt{T_{amb} + 460}}$$

$$\Delta Y_i = \frac{Y_i - \overline{Y}_i}{\overline{Y}_i} \times 100 \qquad \text{Spec.: } \Delta Y_i \le \pm 2\%$$

$$Cal.Error = \frac{\overline{Y}_i - Y_d}{Y_d} \times 100 \qquad \text{Spec.: } Cal.Error \le \pm 5\%$$

CDS005B-Meter Post-CO, February 2004
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CleanAir ENGINEERING

Clean Air Engineering - Meter Box Full Test Calibration

Client: Clean Air 66 **Reviewed By:** R.Redel **Calibration Signature:**

ID No: 66-24 **Calibrated By:** O.Lavrov **Meter Box Yd:** 0.9931

Dept No: Source 66 **Date of Calibration:** 05/14/13 **Meter Box ΔH@:** 1.7476

Meter Box Serial No: 0028-082807-1 **Due Date of Calibration:** 05/14/14 **Barometer Serial No:** W12637

Manufacturer Part No: 0028 **Meter Box Vacuum:** 1.0 in. H_2O **Barometric Pressure:** 28.96 in. Hg

				Standard Meter Gas Volume (ft^3)			Meter Box Gas Volume (ft^3)			Std. Meter Temperature (°F)			Meter Box Temperature (°F)			Time (min.)	Calibration Results	
Q	ΔH	ΔP	Y_{ds}	Initial	Final	V_{ds} Net	Initial	Final	V_d Net	T_{is} In	T_{os} Out	T_{ds} Avg.	T_i In	T_o Out	T_d Avg.	Θ	Y_d	ΔH@
0.379	0.50	-1.20	1.0000	0.000	5.000	5.000	438.041	443.162	5.121	72.5	72.5	72.50	87.0	83.0	85.00	12.64	0.9950	1.8380
0.380	0.50	-1.20	1.0000	0.000	5.000	5.000	443.162	448.282	5.120	72.5	72.5	72.50	88.0	84.0	86.00	12.63	0.9970	1.8318
0.680	1.50	-1.60	1.0000	0.000	10.000	10.000	464.429	464.753	10.324	73.0	73.0	73.00	95.0	85.0	90.00	14.09	0.9917	1.7099
0.680	1.50	-1.60	1.0000	0.000	10.000	10.000	464.753	475.077	10.324	73.0	73.0	73.00	95.0	86.0	90.50	14.09	0.9926	1.7067
0.969	3.00	-2.00	1.0000	0.000	10.000	10.000	412.735	422.980	10.245	72.0	72.0	72.00	94.0	81.0	87.50	9.91	0.9919	1.6978
0.967	3.00	-2.00	1.0000	0.000	10.000	10.000	422.980	433.258	10.278	72.0	72.0	72.00	95.0	82.0	88.50	9.93	0.9905	1.7015
																Averages	0.99310	1.74762

Nomenclature

P_b	Barometric Pressure (in. Hg)
Q	Flow Rate (cfm)
ΔH	Orifice Pressure differential (in. H_2O)
ΔP	Inlet Pressure Differential (in. H_2O)
V_d	Gas Meter Volume - Dry (ft^3)
V_{ds}	Standard Meter Volume - Dry (ft^3)
T_d	Average Meter Box Temperature (°F)
T_o	Outlet Meter Box Temperature (°F)
T_{ds}	Average Standard Meter Temperature (°F)
Y_d	Meter Correction Factor (unitless), $Y_i \leq Y_{avg} \pm 0.02$
Y_{ds}	Standard Meter Correction Factor (unitless)
ΔH@	Orifice Pressure Differential giving 0.75 cfm of air at 68°F and 29.92 in. Hg (in. H_2O) $\Delta H@_i \leq \Delta H@_{avg} \pm 0.2$
Θ	Duration of Run (minutes)

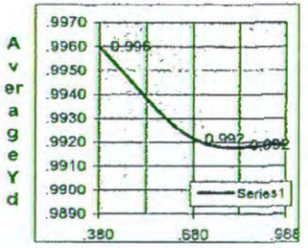
Equations

$$Y_d = (Y_{ds})\left[\frac{V_{ds}}{V_d}\right]\left[\frac{T_d + 460}{T_{ds} + 460}\right]\left[\frac{P_b + \Delta P/13.6}{P_b + \Delta H/13.6}\right]$$

$$\Delta H@ = \frac{(0.0319)(\Delta H)}{P_b(T_o + 460)}\left[\frac{(T_{ds} + 460)\Theta}{(V_{ds})(Y_{ds})}\right]^2$$

$$Q = \frac{17.64(V_{ds})(P_b)}{(T_{ds} + 460)(\Theta)}$$

Average YD vs. Average CFM



Vacuum Gauge

Standard (in.Hg)	Gauge (in.Hg)
4.8	5 0
9.7	10.0
14.8	15.0
19.9	20.0
25.1	25.0

Calibration Reference Information (Standard Meter)

Reference Used: Wet Test Meter Serial No: 11AG9

Calibrated By: Martin Vaquero Date Calibrated: 7/22/2012

Percent Error: 0.245% Calibration Due Date: 7/23/2013

Meter Box Pre-Calibration Inspection

Positive Leak Check:	Pass	Electrical Check:	Pass
Negative Leak Check:	Pass	Pyrometer Checl	Pass
Vacuum Gauge Check	Pass	YD Tolerance: ± 2% of 1.0000	Pass

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Meter Box - Pyrometer Calibration Sheet

Meter Box No: 0028-082807-1

Office: Clean Air 80

Calibrated by: O.Lavrov

Client: Clean Air 66

Date: 5/14/13

Job No: N/A

Temperature Scale Used: Fahrenheit

Type of Calibration: Full-Test

Calibration Reference Settings (°F)	Pyrometer Reading for each Channel (°F)						
	1 Stack	2 Probe	3 Filter	4 Imp Out	5 Aux		
50	51	48	50	51	51		
100	101	98	100	101	101		
150	151	148	150	151	151		
200	201	198	200	201	201		
250	251	248	250	251	251		
300	301	298	300	301	301		
350	351	348	350	351	351		
400	401	398	400	401	401		
450	451	448	450	451	451		
500	501	498	500	501	501		
550	551	548	550	551	551		
600	601	598	600	601	601		

Tolerance = ±2°F difference from reference setting.

Calibration Reference Information

Reference Used: Omega CL23A

Serial No: T-225950

Calibrated By: JH Metrology

Date Calibrated: 10/18/2012

Calibration Report No: 1000164938

Calibration Due Date: 10/18/2013

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Meter Box Critical Orifice Post-Test Calibration Data

Project No. 12461 Meter No. 66-24 Orifice 55-2

Location Houston Lab Meter Yd 0.9931 Orifice K' 0.4659

Test Date 03/31/14 Meter ΔH@ 1.7476 Orifice Cal. Date 04/09/13

Operator Isauro Lopez Full Test Cal. Date 05/14/13

Barom. Press. (P_b) 29.93 in. Hg

Leak Checks

Negative Pressure

No movement of manometer in one-minute ☑ Pass

Positive Pressure

No movement of manometer in one-minute ☑ Pass

Important: All leak checks must pass in order for calibration to be valid.

Run	Elapsed Time (minutes)	Meter Volume (dcf)	Meter Temperature		Ambient Temp. - T_{amb} (°F)	Orifice ΔH (in. W.C.)	Vacuum (in. Hg)	Net Run Time - Θ (minutes)	Net Meter Volume for Run - V_m (dcf)	Avg Meter Temp. for Run - T_m (°F)	DGM Calibration Factor - Y_i	Percent Variation - ΔY_i
			Inlet (°F)	Outlet (°F)								
	0.0	999.10	71	72								
	5.0	1002.06	73	72	72	1.10	22	5.0	2.96	72.0	1.0263	0.4%
	10.0	1005.05	75	71	72	1.10	22	5.0	2.99	72.8	1.0174	-0.5%
	15.0	1008.02	75	72	73	1.10	22	5.0	2.97	73.3	1.0242	0.2%
										Average Y_i	1.0226	
										Cal. Error	3.0%	

Calculations and Specifications

$$Y_i = \frac{K' \times P_b \times (T_m + 460) \times \theta}{17.64 \times V_m \times \left(P_b + {}^{\Delta H}/_{13.6}\right) \times \sqrt{T_{amb} + 460}}$$

$$\Delta Y_i = \frac{Y_i - \overline{Y_i}}{\overline{Y_i}} \times 100 \qquad \text{Spec.: } \Delta Y_i \le \pm 2\%$$

$$Cal.Error = \frac{\overline{Y_i} - Y_d}{Y_d} \times 100 \qquad \text{Spec.: } Cal.Error \le \pm 5\%$$

CDS005B-Meter Post-CO, February 2004
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Sample Probe Calibration

Probe Type: M5 with S-Type Pitot

I.D. Number: 67M5-6-1

Project Number: 12461

Thermocouple Calibration

Reference Type: Thermocouple Reference I.D. No: 67CP-1 Pyrometer I.D. No: 67HHP-1 Units: °F

Point No.	Target Temp.	Reference Temp.	Indicated Temp.	Temp. Difference	% Difference*	Specification
1	Ambient	71.0	71.6	-0.6	0.11%	
2	200°F-250°F	242.0	240.0	2.0	0.28%	%Difference ≤ 1.5

* Based on Absolute Temperature (Rankine)

Does thermocouple assembly meet specifications? ⟶ YES

Pitot Tube Calibration (Wind Tunnel Method @ 56 ft/sec)

Reference Pitot I.D. No: 67STD-C1 Reference Pitot Cp: 0.99

Pitot Side 'A' :

Trial No.	Reference ΔP	Probe ΔP	Probe $C_{p(S)}$*	Abs. Deviation from Avg. $C_{p(A)}$**
1	0.71	1.00	0.834	0.003
2	0.70	1.00	0.828	0.003
3	0.70	0.99	0.832	0.001
		Side 'A' Average Probe $C_{p(A)}$=	0.8316	0.0022

Specification: Avg. C_p Deviations ≤ 0.01

Pitot Side 'B' :

Trial No.	Reference ΔP	Probe ΔP	Probe $C_{p(S)}$*	Abs. Deviation from Avg. $C_{p(B)}$**
1	0.70	1.00	0.828	0.002
2	0.71	1.00	0.834	0.004
3	0.70	1.00	0.828	0.002
		Side 'B' Average Probe $C_{p(B)}$=	0.8303	0.0026

Specification: Avg. C_p Deviations ≤ 0.01

'A' Average C_p		'B' Average C_p		Difference	Specification
0.832	—	0.830	=	0.002	|Difference| ≤ 0.01

Does assembly meet specifications? YES ⟶ If "Yes", C_p= Average of Side 'A' and 'B' Cp values. If "No", Pitot must be replaced.

$$^{*}C_{P(S)} = C_{P(STD)}\sqrt{\frac{\Delta p_{(STD)}}{\Delta p_{(S)}}} \qquad ^{**}Deviation = \left|C_{P(S)} - \overline{C_{P\,(A\text{ or }B)}}\right|$$

All specifications are from EPA-600/9-76-005, section 3.1

Probe Cp= 0.831 Calibrated by: Isauro Lopez Date: 3/16/2014

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COS002C-Pitot_TNL Dec 2008
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Sample Probe Calibration

Probe Type: M5 with S-Type Pitot **I.D. Number:** 67M5-6-10

Project Number: 12461

Thermocouple Calibration

Reference Type: Thermocouple Reference I.D. No: 67CP-1 Pyrometer I.D. No: 67HHP-1 Units: °F

Point No.	Target Temp.	Reference Temp.	Indicated Temp.	Temp. Difference	% Difference*	Specification
1	Ambient	70.8	72.0	-1.2	0.23%	
2	200°F-250°F	244.0	242.0	2.0	0.28%	%Difference ≤ 1.5

* Based on Absolute Temperature (Rankine)

Does thermocouple assembly meet specifications? ⟶ YES

Pitot Tube Calibration (Wind Tunnel Method @ 56 ft/sec)

Reference Pitot I.D. No: 67STD-C1 Reference Pitot Cp: 0.99

Pitot Side 'A' :

Trial No.	Reference ΔP	Probe ΔP	Probe $C_{p(S)}$*	Abs. Deviation from Avg. $C_{p(A)}$**
1	0.70	0.99	0.832	0.000
2	0.70	0.99	0.832	0.000
3	0.70	0.99	0.832	0.000
		Side 'A' Average Probe $C_{p(A)}$=	0.8325	0.0000

Specification: Avg. C_p Deviations ≤ 0.01

Pitot Side 'B' :

Trial No.	Reference ΔP	Probe ΔP	Probe $C_{p(S)}$*	Abs. Deviation from Avg. $C_{p(B)}$**
1	0.70	0.99	0.832	0.001
2	0.70	1.00	0.828	0.003
3	0.70	0.99	0.832	0.001
		Side 'B' Average Probe $C_{p(B)}$=	0.8311	0.0019

Specification: Avg. C_p Deviations ≤ 0.01

'A' Average C_p		'B' Average C_p		Difference	Specification
0.832	—	0.831	=	0.001	|Difference| ≤ 0.01

Does assembly meet specifications? YES ⟶ If "Yes", C_p= Average of Side 'A' and 'B' Cp values. If "No", Pitot must be replaced.

$$^{*}C_{P(S)} = C_{P(STD)}\sqrt{\frac{\Delta p_{(STD)}}{\Delta p_{(S)}}} \qquad ^{**}Deviation = \left|C_{P(S)} - \overline{C}_{P\,(\text{A or B})}\right|$$

All specifications are from EPA-600/9-76-005, section 3.1

Probe Cp= 0.832 Calibrated by: Isauro Lopez Date: 3/16/2014

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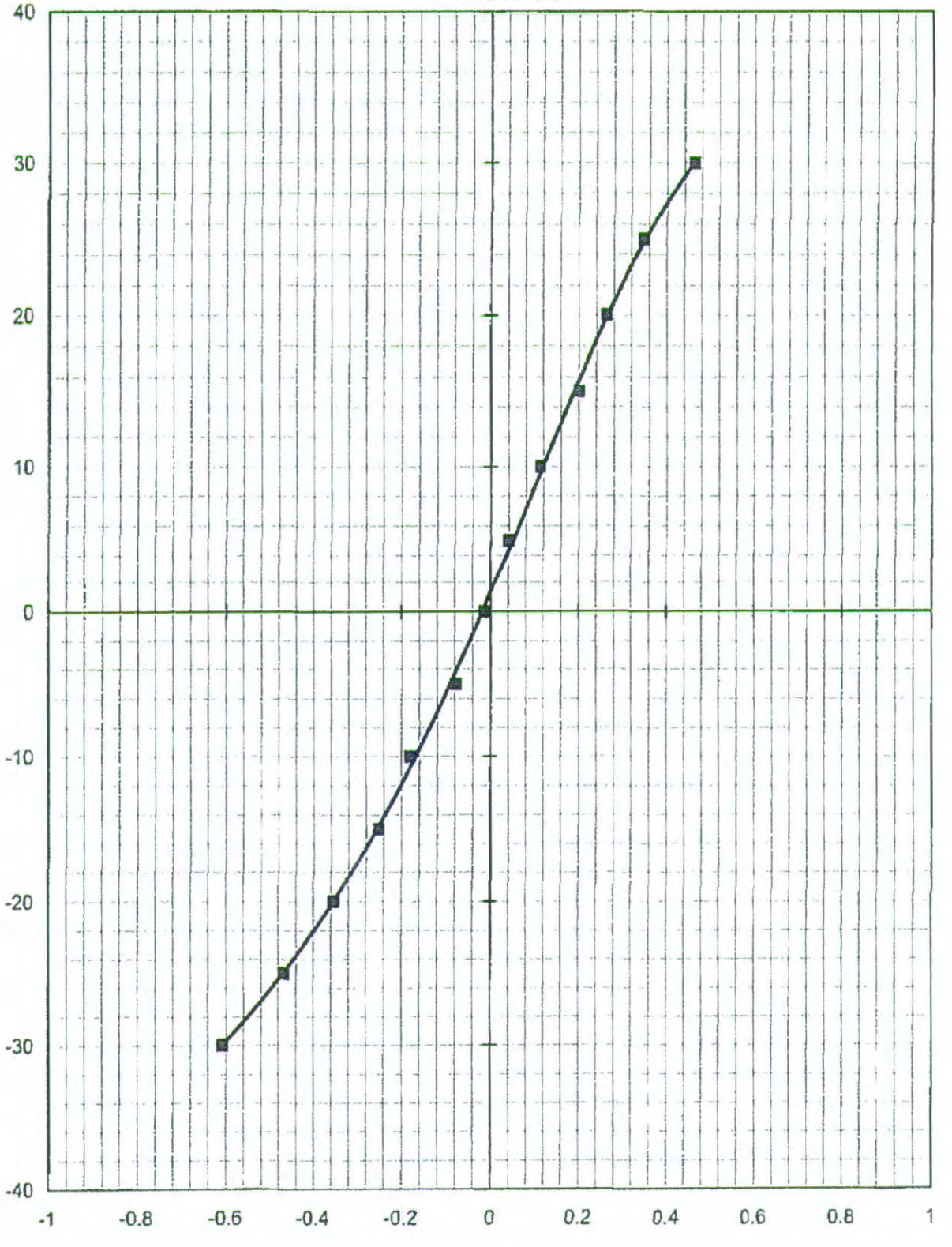
Probe ID: 207722 Probe Type: DAT Date: 3/11/2014

Pitch Angle Calibration Auto Systems

$y = 9.056E+01x^6 + 6.133E+01x^5 - 7.234E+01x^4 - 7.226E+01x^3 + 1.775E+01x^2 + 7.184E+01x + 1.282E+00$

$R^2 = 9.994E-01$

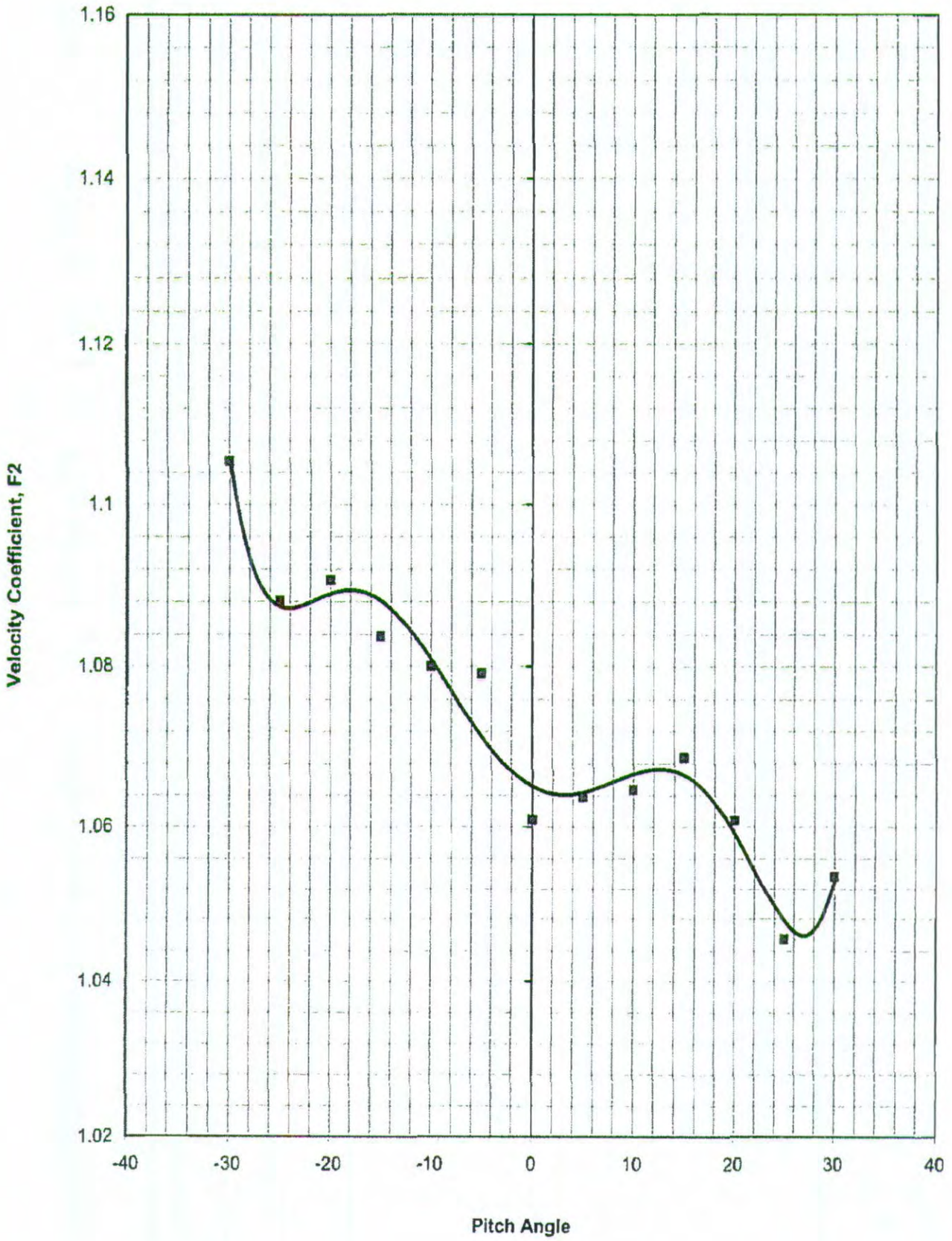


Probe ID: 207722 Probe Type: DAT Date: 3/11/2014

Velocity Coefficient

$y = 2.498E\text{-}10x^6 - 1.960E\text{-}10x^5 - 3.375E\text{-}07x^4 - 1.401E\text{-}08x^3 + 1.173E\text{-}04x^2 - 7.068E\text{-}04x + 1.065E+00$

$R^2 = 9.651E\text{-}01$

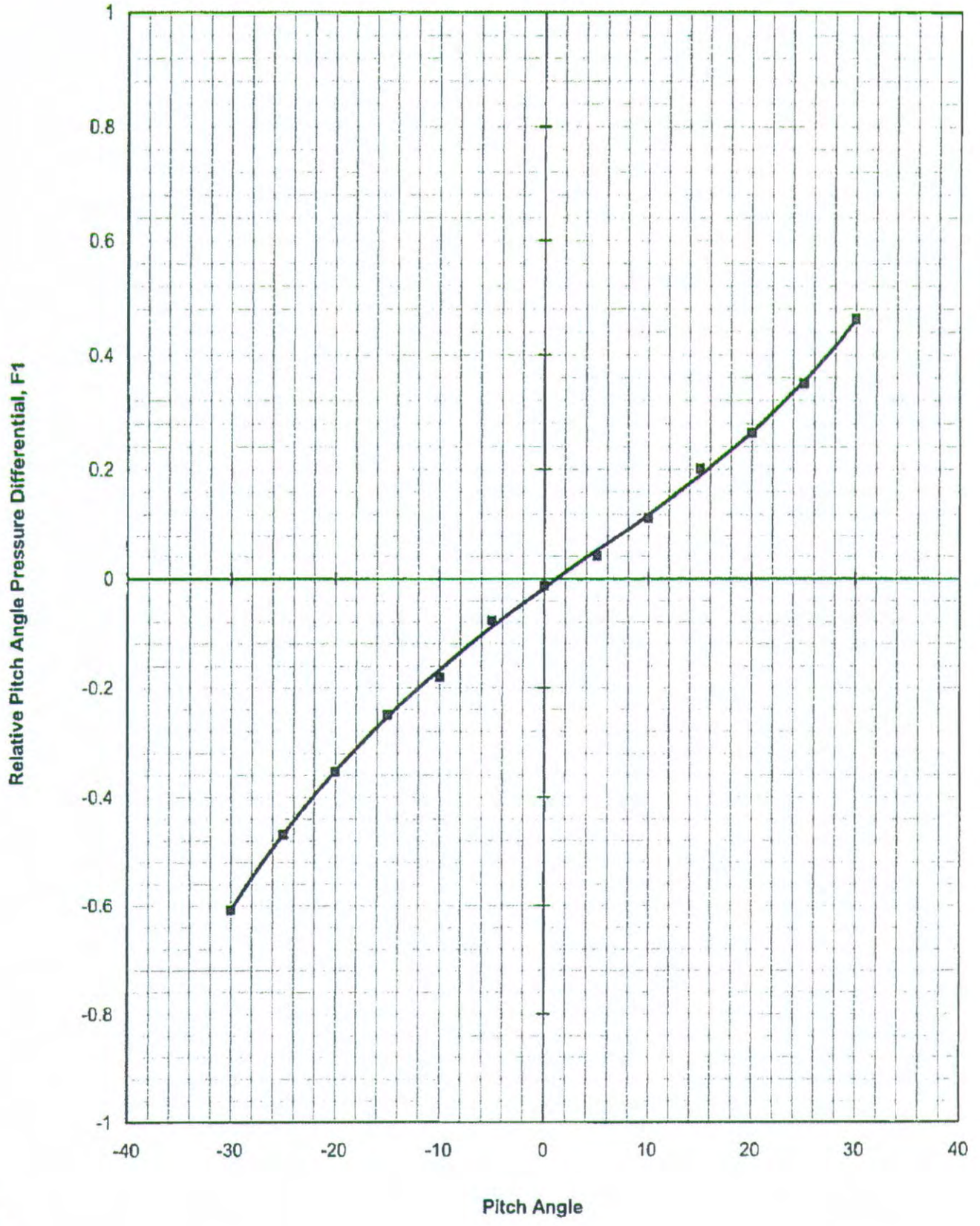


Probe ID: 207722 Probe Type: DAT Date: 3/11/2014

Pitch Angle Calibration

$y = 1.218E\text{-}09x^5 + 9.354E\text{-}09x^4 + 3.152E\text{-}06x^3 - 7.088E\text{-}05x^2 + 1.400E\text{-}02x - 1.736E\text{-}02$

$R^2 = 9.995E\text{-}01$



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Probe ID: 207722 Probe Type: DAT

2F Wind Tunnel Calibration Results

Pitch Angle	F_1 Relative Pitch Δp P4 - P5)/(P1 - P2&	Deviation (%) F_1	F_2 Calibrated Velocity Factor	Deviation (%) F_2	s F2 Deviatio ess Than 3%	Is F2 Deviation Less Than 5%?
0	-0.013	-57.14	1.061	-0.16	Yes	
5	0.041	-6.65	1.064	-0.30	Yes	
10	0.113	-1.49	1.065	-0.09	Yes	
15	0.201	2.34	1.069	-0.45	Yes	
20	0.264	2.59	1.061	0.30	Yes	
25	0.349	-1.70	1.045	-1.16	Yes	
30	0.463	0.75	1.054	0.98	Yes	
-5	-0.077	3.93	1.079	0.13	Yes	
-10	-0.180	3.02	1.080	0.30	Yes	
-15	-0.250	1.94	1.084	-0.17	Yes	
-20	-0.354	-1.04	1.091	0.91	Yes	
-25	-0.469	-3.58	1.088	-0.24	Yes	
-30	-0.608	-5.66	1.105	-1.30	Yes	

alibrated By: W. Berry Date: 3/11/2014

Signature: Test Location: CleanAir Palatine, IL

v2da12/10

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Probe ID: 207722 Probe Type: DAT Date: 3/11/2014

60 fps Data Reduction for 3-D Pitot Calibration

Standard Pitot Readings:	DP_{std}	T_{std}	P_b	C_{pstd}	V_{std}	Temp Offset
Pre-Test:	0.78	69.3	28.76	0.99	59.71	
Post Test:	0.78	69.3	28.74	0.99	59.73	
Transducer Averages:	0.779	72.74	28.77	0.99	59.85	3.9

Pitch Angle	$P_1 - P_{2\&3}$	$P_4 - P_5$	Average $P_1 - P_{2\&3}$	Average $P_4 - P_5$	$F_{1\,\Delta p}$ Relative Pitot Square Root $P4-P5/P1-P2\&3$	ΔP	% Deviation $P_1 - P_{2\&3}$
0	0.68063	-0.01129	0.681	-0.011	-0.017	0.825	-0.22
5	0.68277	0.02608	0.683	0.029	0.042	0.827	-0.21
10	0.68221	0.07705	0.684	0.078	0.114	0.827	-0.47
15	0.67464	0.133	0.681	0.135	0.198	0.825	-1.89
20	0.68946	0.1776	0.690	0.180	0.261	0.830	-0.01
25	0.69588	0.24701	0.698	0.246	0.352	0.836	-0.71
30	0.6964	0.31761	0.692	0.319	0.461	0.832	1.31
30	0.68735	0.32023					
25	0.70086	0.24408					
20	0.68956	0.18171					
15	0.68749	0.13713					
10	0.68544	0.07905					
5	0.68421	0.03156					
0	0.68213	-0.01148					
-5	0.65861	-0.04864	0.650	-0.049	-0.076	0.806	2.62
-10	0.6577	-0.11439	0.652	-0.116	-0.177	0.807	1.84
-15	0.64725	-0.15572	0.646	-0.160	-0.248	0.803	0.51
-20	0.64214	-0.2257	0.638	-0.227	-0.356	0.799	1.17
-25	0.62989	-0.29832	0.628	-0.300	-0.477	0.793	0.52
-30	0.59727	-0.37159	0.599	-0.375	-0.625	0.774	-0.68
-30	0.60133	-0.378					
-25	0.62661	-0.30164					
-20	0.63468	-0.22837					
-15	0.64393	-0.16419					
-10	0.6457	-0.11682					
-5	0.64155	-0.04983					

Pitch Angle	$P_4 - P_5$	F_2 Calibrated Velocity Factor	F_2 % Deviation	F2 Deviation Less Than	Ave F_2 Calibrated Velocity Factor	DP_{std}	Average DP_{std}
0	-1.67	1.0664	0.89	Yes	1.0617	0.78977	0.783655
5	-19.01	1.0692	0.73	Yes	1.0653	0.79634	0.79144
10	-2.56	1.0699	0.89	Yes	1.0652	0.79681	0.791635
15	-3.06	1.0774	1.17	Yes	1.0711	0.79903	0.79728
20	-2.29	1.0571	-0.38	Yes	1.0592	0.78616	0.789235
25	1.19	1.0546	0.59	Yes	1.0515	0.78971	0.787905
30	-0.82	1.0458	-0.53	Yes	1.0486	0.77716	0.776185
30		1.0514	0.53	Yes		0.77521	
25		1.0485	-0.58	Yes		0.7861	
20		1.0612	0.38	Yes		0.79231	
15		1.0650	-1.16	Yes		0.79553	
10		1.0604	-0.89	Yes		0.78646	
5		1.0615	-0.72	Yes		0.78654	
0		1.0570	-0.89	Yes		0.77754	
-5	-2.42	1.0724	-1.12	Yes	1.0785	0.77284	0.77143
-10	-2.10	1.0791	0.14	Yes	1.0784	0.78145	0.77324
-15	-5.30	1.0839	-0.13	Yes	1.0847	0.77591	0.774955
-20	-1.18	1.0840	-0.31	Yes	1.0856	0.7698	0.767715
-25	-1.11	1.0846	-0.87	Yes	1.0894	0.75607	0.760695
-30	-1.71	1.1173	0.85	Yes	1.1126	0.76079	0.756945
-30		1.1079	-0.84	Yes		0.7531	
-25		1.0941	0.87	Yes		0.76532	
-20		1.0873	0.31	Yes		0.76563	
-15		1.0854	0.13	Yes		0.774	
-10		1.0776	-0.14	Yes		0.76503	
-5		1.0846	1.14	Yes		0.77002	

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Probe ID: 207722 Probe Type: DAT Date: 3/11/2014

90 fps Data Reduction for 3-D Pitot Calibration

Standard Pitot Readings:	DP_{std}	T_{std}	P_b	C_{pstd}	V_{std}	Temp Offset
Pre-Test:	1.8	70.3	28.74	0.99	90.83	
Post Test:	1.8	70.3	28.73	0.99	90.84	
Transducer Averages:	1.805	73.99	28.75	0.99	91.26	3.9

Pitch Angle	$P_1 - P_{283}$	$P_4 - P_5$	Average $P_1 - P_{283}$	Average $P_4 - P_5$	$F_{1\,\Delta p}$ Relative Pitot $P4 - P5/P1 - P283$	Square Root ΔP	% Deviation $P_1 - P_{283}$
0	1.59476	-0.01463	1.592	-0.015	-0.0093	1.262	0.39
5	1.57973	0.0607	1.583	0.062	0.039	1.258	-0.40
10	1.59038	0.17372	1.585	0.178	0.112	1.259	0.72
15	1.58353	0.31548	1.582	0.321	0.203	1.258	0.14
20	1.59754	0.42143	1.587	0.424	0.267	1.260	1.31
25	1.63786	0.56622	1.644	0.568	0.346	1.282	-0.80
30	1.58024	0.73396	1.576	0.732	0.464	1.255	0.50
30	1.57231	0.73008					
25	1.65098	0.57064					
20	1.57677	0.42732					
15	1.58127	0.32702					
10	1.57898	0.18266					
5	1.58611	0.0642					
0	1.58851	-0.01492					
-5	1.49843	-0.11809	1.513	-0.119	-0.079	1.230	-1.90
-10	1.5289	-0.26864	1.517	-0.277	-0.183	1.232	1.59
-15	1.50583	-0.38156	1.505	-0.380	-0.253	1.227	0.15
-20	1.46986	-0.51327	1.465	-0.516	-0.352	1.210	0.66
-25	1.47383	-0.6711	1.463	-0.674	-0.461	1.209	1.50
-30	1.42457	-0.8392	1.419	-0.839	-0.591	1.191	0.77
-30	1.41364	-0.83813					
-25	1.45183	-0.67673					
-20	1.46025	-0.51795					
-15	1.50355	-0.37868					
-10	1.50481	-0.28601					
-5	1.52723	-0.12024					

Pitch Angle	$P_4 - P_5$	F_2 Calibrated Velocity Factor	F_2 % Deviation	F2 Deviation Less Than	Ave F_2 Calibrated Velocity Factor	DP_{std}	Average DP_{std}
0	-1.96	1.0548	-0.99	Yes	1.0601	1.81025	1.824845
5	-5.60	1.0615	-0.12	Yes	1.0622	1.81623	1.822105
10	-5.02	1.0627	-0.29	Yes	1.0642	1.8326	1.831245
15	-3.59	1.0665	0.03	Yes	1.0663	1.8377	1.835845
20	-1.39	1.0552	-1.35	Yes	1.0623	1.81474	1.82761
25	-0.78	1.0407	0.26	Yes	1.0394	1.81007	1.812665
30	0.53	1.0579	-0.18	Yes	1.0589	1.80446	1.80322
30		1.0598	0.18	Yes		1.80198	
25		1.0381	-0.26	Yes		1.81526	
20		1.0696	1.37	Yes		1.84048	
15		1.0662	-0.03	Yes		1.83399	
10		1.0658	0.29	Yes		1.82989	
5		1.0628	0.12	Yes		1.82798	
0		1.0653	1.00	Yes		1.83944	
-5	-1.80	1.0899	1.88	Yes	1.0798	1.8161	1.799785
-10	-6.26	1.0786	-0.57	Yes	1.0816	1.81472	1.810675
-15	0.76	1.0833	0.08	Yes	1.0828	1.80289	1.800145
-20	-0.91	1.0936	-0.36	Yes	1.0956	1.79364	1.79423
-25	-0.84	1.0829	-0.72	Yes	1.0868	1.76331	1.76277
-30	0.13	1.0958	-0.44	Yes	1.0982	1.74527	1.746245
-30		1.1006	0.44	Yes		1.74722	
-25		1.0907	0.72	Yes		1.76223	
-20		1.0976	0.36	Yes		1.79482	
-15		1.0824	-0.08	Yes		1.7974	
-10		1.0847	0.57	Yes		1.80663	
-5		1.0698	-1.84	Yes		1.78347	

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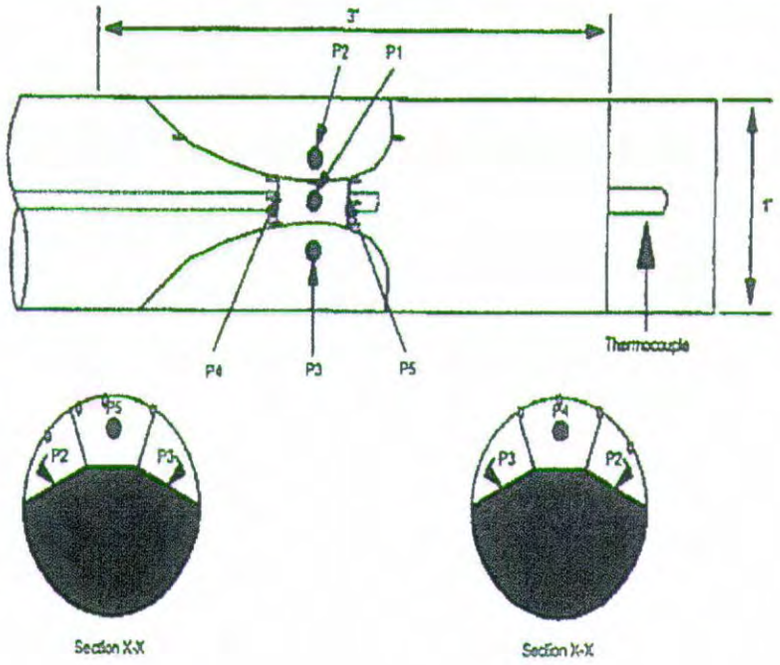
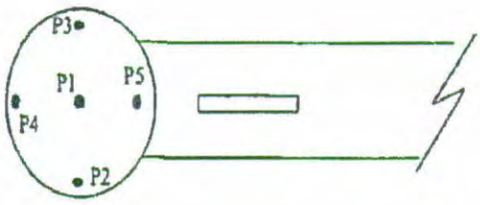
Probe ID: 207722 Probe Type: DAT Date: 3/11/2014

Probe Inspection Sheet





CleanAir.

CleanAir Instrument Rental
500 W. Wood Street
Palatine, IL 60067-4975
800-553-5511
www.cleanair.com

Probe ID: 207722 Probe Type: DAT Date: 3/11/2014

Previous calibration Date: 2/13/2014

Probe Inspection Sheet

Fill in tables below. Show the location in the accompanying probe diagram for any item with a value of "1"

Inspection of Probe Ports

Port ID	Current Inspection (1=present, 0=absent)			Compared to previous Calibration (1=changed, 0=unchanged)			Description of items with a value = 1
	Dents	Scratches	Asymmetrics	Dents	Scratches	Asymmetrics	
P1	0	0	0	0	0	0	
P2	0	0	0	0	0	0	
P3	0	0	0	0	0	0	
P4	0	0	0	0	0	0	
P5	0	0	0	0	0	0	

Inspection of Probe Surfaces

Surface ID	Current Inspection (1=present, 0=absent)		Compared to previous Calibration (1=changed, 0=unchanged)		Description of items with a value = 1
	Scratches	Indentations	Scratches	Indentations	
P1	0	1	0	0	1 dent on edge
P2	1	1	0	0	1 scratch & 1 dent on edge
P3	0	0	0	0	
P4	0	1	0	0	3 dents top edge & 1 dent each corner
P5	0	1	0	0	3 dents top edge & 1 dent each corner

Surface IDs S1 through S5 refer to surfaces adjacent to pressure ports with corresponding numbers

QA/QC Check

Completeness: x

Legibility: x

Accuracy: x

Specifications: x

Reasonableness x

Certification

I certify that that prode ID 207722 meets or exceeds all specfications, criteria, and/or all the applicable design features required under EPA Method 2F.

Certified By: Wayne Rau

Date: 3/11/14

CleanAir

CleanAir Instrument Rental
500 W. Wood Street
Palatine, IL 60067-4975
800-553-5511
www.cleanair.com

Probe ID: 207722 Probe Type: DAT Date: 03/11/14

Yaw Angle Calibration

Nominal Velocity Setting ft/sec	Repetition 1		Repetition 2	
	0_{null}*	R_{SLO}*	0_{null}*	R_{SLO}*
60	88.5	1.5	88.5	1.5
90	88.4	1.6	88.5	1.5

*Include magnitude and algebraic sign in accordance with section 10.5.7

Average of all recorderd R_{SLO} values: 1.525

Calibrated By: W. Berry Signature:

Test Location: CleanAir Palatine, IL.

Inclinometer Calibration Checks

Inclin.ASSET #	203948
Date:	3/11/2014
Calibrated by:	W. Berry

Triangular Block Cal Point	Reading, Degrees	
Side A	44.3	R1
Side B	44.1	R2
	91.6	180-R1-R2
Actual Angle	92	
Difference	-0.4	+/- 2deg?

Pressure Transducer Calibration Checks

Transducer ASSET #: 264543
Date: 3/11/2014
Calibrated by: W Berry

Cal Point % of Scale	Approx "w.c.	Manometer $P_{s1}-P_{atm}$	Transducer $P_{s1}-P_{atm}$	Difference "w.c.	< 0.2 ?	Manometer $P_{s1}-P_3$	Transducer $P_{s1}-P_3$	Difference "w.c.	< 0.2 ?	Manometer DP_{ave}	Transducer DP_{ave}	Difference "w.c.	< 0.2 ?	Barometer Pb	Transducer Pabs	Difference "Hg
0%	0.00	0.00	-0.00074	-0.00074		0.00	-0.00467	-0.00467		0.00	-0.00013	-0.00013		28.72	28.749441	0.02
-30%	0.60	0.6	0.60021	0.00021		0.6	0.59833	-0.00167		0.6	0.59711	-0.00289				
-60%	1.20	1.2	1.20398	0.00398		1.19	1.18537	-0.00463		1.2	1.1976	-0.00240				
-90%	1.80	1.81	1.80085	0.00085		1.79	1.78871	-0.00129		1.81	1.80093	-0.00907				

Temperature Check			
Hg in Glass	FlowKinetics		
deg F	deg F	Offset	
70	66.35	3.65	

Raw Data Collection — % of Scale 0%

Average: -0.00074, -0.00467, -0.00013, 390.87, 66.35

Reading No	Time (secs)	P1 (in H2O (6	P2 (in H2(	P3 (in H2(	Pabs (in H2O	Temp. stag. (°	Temp. stat. (°I	Rel. Humi	Density (kg/m³)
1	0	-0.0027	-0.0058	0.0008	390.87	66.4	66.4	28	1.18
2	2.392	-0.0018	-0.0042	0.0014	390.88	66.4	66.4	28	1.18
3	3.576	-0.0015	-0.0048	0.0008	390.87	66.4	66.4	28	1.18
4	4.784	-0.0017	-0.0021	-0.0001	390.87	66.4	66.4	28	1.18
5	5.976	-0.0008	-0.0055	-0.0013	390.87	66.4	66.4	28	1.18
6	7.176	0.0001	-0.0079	0.0005	390.87	66.4	66.4	28	1.18
7	8.408	-0.0017	-0.0051	-0.003	390.87	66.4	66.4	29	1.18
8	9.592	-0.0013	-0.003	0.0015	390.87	66.4	66.4	28	1.18
9	10.784	0	-0.0047	-0.0013	390.87	66.4	66.4	29	1.18
10	12	0.0012	-0.0035	-0.0006	390.87	65.9	65.9	29	1.18
11	13.192	0.0001	-0.0061	0.0008	390.88	66.4	66.4	29	1.18

Raw Data Collection — % of Scale -30%

Average: 0.00021, 0.59833, 0.59711, 390.871, 68.29

Reading No	Time (secs)	P1 (in H2O (6	P2 (in H2(	P3 (in H2(	Pabs (in H2O	Temp. stag. (°	Temp. stat. (°I	Rel. Humi	Density (kg/m³)
1	0	0.5968	0.6005	0.5879	390.87	68.4	68.1	28	1.15
2	2.552	0.6073	0.6086	0.6078	390.88	68.4	68.1	27	1.15
3	3.868	0.6165	0.5992	0.593	390.87	68.4	68.1	27	1.15
4	5.072	0.6057	0.6077	0.6095	390.87	68.8	68.6	27	1.15
5	6.338	0.5975	0.5979	0.6012	390.88	68.4	68.1	27	1.15
6	7.6	0.6018	0.6053	0.6007	390.87	68.4	68.1	27	1.15
7	8.872	0.597	0.608	0.588	390.89	68.4	68.1	27	1.15
8	10.136	0.6084	0.5983	0.5915	390.87	68.4	68.1	27	1.15
9	11.4	0.5893	0.5991	0.5995	390.87	67.9	67.6	27	1.15
10	12.672	0.5772	0.5842	0.5944	390.88	68.4	68.1	27	1.15
11	13.944	0.6014	0.5981	0.5855	390.88	68.4	68.1	27	1.15

Raw Data Collection — % of Scale -60%

Average: 1.20398, 1.18537, 1.1976, 390.922, 67.9

Reading No	Time (secs)	P1 (in H2O (6	P2 (in H2(	P3 (in H2(	Pabs (in H2O	Temp. stag. (°	Temp. stat. (°I	Rel. Humi	Density (kg/m³)
1	0	1.1993	1.1418	1.1482	390.92	67.9	67.4	27	1.15
2	2.28	1.2023	1.1778	1.1955	390.92	67.9	67.4	27	1.15
3	3.424	1.1991	1.1876	1.212	390.92	67.9	67.4	28	1.15
4	4.568	1.1909	1.1568	1.1839	390.92	67.9	67.4	27	1.15
5	5.712	1.1965	1.2036	1.172	390.92	67.9	67.4	27	1.15
6	8.856	1.1929	1.1731	1.1875	390.93	67.9	67.4	28	1.15
7	7.992	1.2033	1.1889	1.1971	390.92	67.9	67.4	27	1.15
8	9.144	1.2335	1.192	1.1907	390.92	67.9	67.4	27	1.15
9	10.28	1.2138	1.2044	1.2131	390.92	67.9	67.4	27	1.15
10	11.424	1.2128	1.184	1.2193	390.92	67.9	67.4	28	1.15
11	12.568	1.2049	1.2055	1.2049	390.93	67.9	67.4	28	1.15

Raw Data Collection — % of Scale -90%

Average: 1.80085, 1.78871, 1.80093, 390.923, 68.25

Reading No	Time (secs)	P1 (in H2O (6	P2 (in H2(	P3 (in H2(	Pabs (in H2O	Temp. stag. (°	Temp. stat. (°I	Rel. Humi	Density (kg/m³)
1	0	1.7758	1.7884	1.812	390.92	67.9	67.2	28	1.15
2	2.288	1.7928	1.7916	1.8088	390.93	68.4	67.7	27	1.15
3	3.424	1.8391	1.805	1.8187	390.92	68.4	67.7	27	1.15
4	4.568	1.8022	1.7309	1.7868	390.92	68.4	67.7	28	1.15
5	5.72	1.7835	1.7581	1.7923	390.92	67.9	67.2	27	1.15
6	6.856	1.8069	1.7855	1.7509	390.92	68.4	67.7	27	1.15
7	8	1.8187	1.8092	1.8348	390.92	68.4	67.7	27	1.15
8	9.136	1.8078	1.8244	1.7944	390.92	68.4	67.7	27	1.15
9	10.28	1.819	1.777	1.8142	390.93	67.9	67.2	27	1.18
10	11.424	1.825	1.8089	1.8107	390.93	68.4	67.7	27	1.15
11	12.568	1.8255	1.7905	1.7993	390.92	67.9	67.2	27	1.18

TRANSCAT®
CALIBRATION SERVICES • TEST & MEASUREMENT INSTRUMENTS

PICK LIST 12:15:35 1/16/14
PL Run 1448421

01CH1CU00

Transcat, Inc.
100 Dobbs Lane
CHERRY HILL NJ 08034

Ship To: CLEAN AIR ENGINEERING
321 CENTURY PLAZA
SUITE 130
UNITED STATES
HOUSTON TX 77073

Order 01/06/14
1/06/14
CKEARNEY CWHANN

Co/Cust	P.O. No	Order No	Ship Via	WH
01/0000561724	05138-67-65000	CH1CU/00	UPS Ground	06

Item Number/Description	Ordered	Shipped	B/O	U/M	Loc Seq
Contact REBECCA ATKINSON			719-502-6960		
Carrier: UPS Ground					
001. PM0305-6	1.000	1.000	.000	EA	BELOW
Cal&Data-ACCULAB Mdl:VIC-5101,Balance, 0 to 5,000 g, ±0.2g					
LOC: ZZ.99.99					
S/N:25854765 UNIT ID:67-IB-6					
access: pwr cord, case					
002. REVA01	1.000	1.000	.000	EA	BELOW
BER-OHAUS Mdl:TP4KS,Balanc e					
LOC: ZZ.99.99					
S/N:2320 UNIT ID:67-IB-1					
access: pwr cord, case					
003. RM0102-9	1.000	.000	1.000	EA	BELOW
Cal&Uncerty-TROEMNER/TALBOYS Mdl:8132,Weight , 500 g , Class 1					
S/N:1000016470 UNIT ID:None					
access: cylindrical case					

* CONTINUED *

Calibration Items Inspected by: _____ Date: _____

Equal Opportunity/Affirmative Action Employer, H/V

PICKD

TRANSCAT®
CALIBRATION SERVICES • TEST & MEASUREMENT INSTRUMENTS

PICK LIST 12:15:35 1/16/14
PL Run 1448421

01CH1CU00

Transcat, Inc.
100 Dobbs Lane
CHERRY HILL NJ 08034

Ship To: CLEAN AIR ENGINEERING
321 CENTURY PLAZA
SUITE 130
UNITED STATES
HOUSTON TX 77073

Order 01/06/14
1/06/14
CKEARNEY CWHANN

Co/Cust	P.O. No	Order No	Ship Via	WH
01/0000561724	05138-67-65000	CH1CU/00	UPS Ground	06

Item Number/Description	Ordered	Shipped	B/O	U/M	Loc Seq
Contact REBECCA ATKINSON			719-502-6960		
004. RM0102-9	1.000	.000	1.000	EA	BELOW
Cal&Uncerty-TROEMNER/TALBOYS Mdl:8132,Weight , 500 g , Class 1					
S/N:1000016468 UNIT ID:None					
12 month calibration interval					
access: cylindrical case					

* COMPLETE *

Equal Opportunity/Affirmative Action Employer, H/V

PICKD

TRANSCAT® TRANSCAT.COM 800.828.1470

NVLAP®

NVLAP LAB CODE 200902-0

CERTIFICATE OF CALIBRATION

Customer: CLEAN AIR ENGINEERING
321 CENTURY PLAZA
SUITE 130
HOUSTON, TX 77073

Customer Nbr: 1-561724-000
PO Nbr: 05138-67-65000
Date Received: January 07, 2014

Cert/SO Nbr: 6-CH1CU-2-1
Manufacturer: Acculab
Model Nbr: VIC-5101

Date Completed: January 15, 2014
Due Date: January 15, 2015

Description: Balance, 0 to 5,000 g, ±0.2g
Serial Nbr: 25854765
ID Nbr: 67-IB-6
Unit Barcode: 901B0053861

Calibrated To: Manufacturer Specification
Calibration Proc: 1-AC25484-0
Item Received: Out Of Tolerance
Item Returned: In Tolerance

For calibration data, see Supplemental Report for SO Nbr 6-CH1CU-2-1

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2005. Accredited calibrations performed within the Labs Scope of Accreditation are indicated by the presence of the Accrediting Body's Logo and Certificate Number on this Certificate of Calibration. Any measurements on an accredited calibration not covered by that Labs Scope are listed in the notes section of the certificate. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Transcat calibrations, as applicable, are performed in compliance with the requirements of ISO9001:2008, ISO TS16949, ANSI/NCSL Z540-1994, and ISO 10012-1992. When specified contractually the requirements of 10CFR21, 10CFR50 App. B and NQA-1 are also covered.

Traceability includes no less than An unbroken chain of comparison, realization of SI units, measurement uncertainty, documentation, competence, periodic recalibration, and measurement assurance. Transcat documents the traceability of measurements to the SI units through the National Institute of Standards and Technology(NIST) or the National Research Council of Canada(NRC), or other recognized national measurement institutes (NMI's) or international standard bodies, or to measurable conditions created in our laboratory, or accepted fundamental and/or natural physical constants, ratio type of calibration, or by comparison to consensus standards. The specific path of traceability for the reported measurement results is maintained at the Transcat facility and is available there for review.

Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are shown on the Supplemental Report.

The results in this report relate only to the item calibrated or tested and the determination of in or out of tolerance is specific to the model/serial no. referenced above based on the tolerances shown on the supplemental report; these tolerances are either the original equipment manufacturer's (OEM's) warranted specifications or the client's requested specifications.

The applied uncertainty is the uncertainty of the calibration process. The Test Uncertainty Ratio (TUR) is calculated as per NCSL International RP-9, section 8.2. All calibrations have been performed using processes having a TUR of 4 : 1 or better (3:1 for mass calibrations), unless otherwise noted on the Supplemental Report. Uncertainties have been estimated at a 95 percent confidence level(k=2). Calibration at a 4:1 TUR (or greater) provides reasonable confidence that the instrument is within the stated tolerances. For measuring instruments, in order to consider the contribution to the uncertainty from reproducibility of the unit under test (UUT), add 0.6 of the UUT's least significant digit to the reported uncertainty. For mass calibrations, Conventional mass referenced to 8.0 g/cm³.

Any number of factors can cause a unit to drift out of tolerance at any time following its calibration. Limitations on the uses of this instrument are detailed in the OEM's operating instructions.

Notes: Unit was received out of tolerance, verified and adjusted to meet manufacturer's specifications.

Calibrated At:
100 Dobbs Lane
Cherry Hill, NJ 08034
By: Ernest Brown
Digitally Signed On January 15, 2014

Facility Responsible:
100 Dobbs Lane
Cherry Hill, NJ 08034
856-489-9453

Digitally Signed By Joshua Underwood for
Date: January 15, 2014
Derek Still
Lab Manager

F0013R23 03/08/13

Revision 0

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SUPPLEMENTAL REPORT FOR 6-CH1CU-2-1

CALIBRATION LAB DATA AS FOUND

Service Order Nbr:	6-CH1CU-2-1	Mfg:	Acculab
Description:	Balance, 0 to 5,000 g, ±0.2g	Model:	VIC-5101
Serial:	25854765		
Customer:	CLEAN AIR ENGINEERING		
Calibrated:	January 15, 2014	PO Nbr:	05138-67-65000
Date Due:	January 15, 2015	ID Nbr:	67-IB-6
Service Type:	R6	Calibration Proc:	1-AC25484-0

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found	OOT	Uncertainty (k=2; ±)		TUR
Weight Measurement									
Linearity	100.0g	±(0.2 g)	99.8	100.2	100.9 g	*			
	500.0g	±(0.2 g)	499.8	500.2	504.4 g	*			
	1000.0g	±(0.2 g)	999.8	1000.2	1008.8 g	*			
	3000.0g	±(0.2 g)	2999.8	3000.2	3026.5 g	*			
	5000.0g	±(0.2 g)	4999.8	5000.2	5044.3 g	*			
Repeatability	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				

The reported uncertainty is the uncertainty of the calibration process For measuring instruments add 0.6 of the least significant digit to the reported uncertainty to obtain the measurement uncertainty of the unit under test at the pocific test point.

Reported resolution of the UUT does not represent calibration uncertainty or accuracy of the UUT

Field not applicable.

SUPPLEMENTAL REPORT FOR 6-CH1CU-2-1

CALIBRATION LAB DATA AS FOUND

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found	&/or	Uncertainty (k=2; ±)		TUR
	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				
Repeatability Average					0.00 g				
Standard Deviation		±(0.1 g)	-0.10	0.10	0.00 g				

As Found Data recorded on January 15, 2014

Temperature: 68.9°F / 20.5°C Relative Humidity: 39% Temp/RH Asset: J882

Asset	Manufacturer	Model	Description	Cal Date	Due Date	Traceability Numbers
J466	Troemner	7215-1	Weight Set , 2 kg to 1 mg , Class 1 , 26 Pcs.	July 24, 2013	July 31, 2014	6-&J466-1007-1

Remarks:

Unit was received out of tolerance, verified and adjusted to meet manufacturer's specifications.

The reported uncertainty is the uncertainty of the calibration process For measuring instruments add 0.6 of the least significant digit to the reported uncertainty to obtain the measurement uncertainty of the unit under test at the specific tespoint.

Reported resolution of the UUT does not represent calibration uncertainty or accuracy of the UUT

Field not applicable.

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SUPPLEMENTAL REPORT FOR 6-CH1CU-2-1

CALIBRATION LAB DATA AS LEFT

Service Order Nbr:	6-CH1CU-2-1	Mfg:	Acculab
Description:	Balance, 0 to 5,000 g, ±0.2g	Model:	VIC-5101
Serial:	25854765		
Customer:	CLEAN AIR ENGINEERING		
Calibrated:	January 15, 2014	PO Nbr:	05138-67-65000
Date Due:	January 15, 2015	ID Nbr:	67-IB-6
Service Type:	R6	Calibration Proc:	1-AC25484-0

Description	Setpoints	Accuracy	Low Limit	High Limit	As Left	OOT	Uncertainty (k=2; ±)		TUR
Weight Measurement									
Linearity	100.0g	±(0.2 g)	99.8	100.2	100.0 g				
	500.0g	±(0.2 g)	499.8	500.2	500.0 g				
	1000.0g	±(0.2 g)	999.8	1000.2	1000.0 g				
	3000.0g	±(0.2 g)	2999.8	3000.2	3000.0 g				
	5000.0g	±(0.2 g)	4999.8	5000.2	5000.0 g				
Repeatability	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				

The reported uncertainty is the uncertainty of the calibration process For measuring instruments add 0.6 of the least significant digit to the reported uncertainty to obtain the measurement uncertainty of the unit under test at the pecific test point.

Reported resolution of the UUT does not represent calibration uncertainty or accuracy of the UUT

Field not applicable.

SUPPLEMENTAL REPORT FOR 6-CH1CU-2-1

CALIBRATION LAB DATA AS LEFT

Description	Setpoints	Accuracy	Low Limit	High Limit	As Left	✓	Uncertainty (k=2; ±)		TUR
	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				
	3000.0g				0.0 g				
Repeatability Average					0.00 g				
Standard Deviation		±(0.1 g)	-0.10	0.10	0.00 g				

As Left Data recorded on January 15, 2014

Temperature: 69.2°F / 20.7°C Relative Humidity: 39% Temp/RH Asset: J882

Asset	Manufacturer	Model	Description	Cal Date	Due Date	Traceability Numbers
J466	Troemner	7215-1	Weight Set , 2 kg to 1 mg , Class 1 , 26 Pcs.	July 24, 2013	July 31, 2014	6-&J466-1007-1

Remarks:

Unit was received out of tolerance, verified and adjusted to meet manufacturer's specifications.

The reported uncertainty is the uncertainty of the calibration process For measuring instruments, add 0.6 of the least significant digit to the reported uncertainty to obtain the measurement uncertainty of the unit under test at the specific setpoint.

Reported resolution of the UUT does not represent calibration uncertainty or accuracy of the UUT

Field not applicable.

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CALIBRATION LAB OUT OF TOLERANCE DATA AS FOUND

Service Order Nbr:	6-CH1CU-2-1	Mfg:	Acculab
Description:	Balance, 0 to 5,000 g, ±0.2g	Model:	VIC-5101
Serial:	25854765		
Customer:	CLEAN AIR ENGINEERING		
Calibrated:	January 15, 2014	PO Nbr:	05138-67-65000
Date Due:	January 15, 2015	ID Nbr:	67-IB-6
Service Type:	R6	Calibration Proc:	1-AC25484-0

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found	OOT	Uncertainty (k=2; ±)		TUR
Weight Measurement									
Linearity	100.0g	±(0.2 g)	99.8	100.2	100.9 g	*			
	500.0g	±(0.2 g)	499.8	500.2	504.4 g	*			
	1000.0g	±(0.2 g)	999.8	1000.2	1008.8 g	*			
	3000.0g	±(0.2 g)	2999.8	3000.2	3026.5 g	*			
	5000.0g	±(0.2 g)	4999.8	5000.2	5044.3 g	*			

As Found Data recorded on January 15, 2014

Temperature: 68.9°F / 20.5°C Relative Humidity: 39% Temp/RH Asset: J882

Asset	Manufacturer	Model	Description	Cal Date	Due Date	Traceability Numbers
J466	Troemner	7215-1	Weight Set , 2 kg to 1 mg , Class 1 , 26 Pcs.	July 24, 2013	July 31, 2014	6-&J466-1007-1

The reported uncertainty is the uncertainty of the calibration process For measuring instruments add 0.6 of the least significant digit to the reported uncertainty to obtain the measurement uncertainty of the unit under test at the specific test point.

Reported resolution of the UUT does not represent calibration uncertainty or accuracy of the UUT

CALIBRATION LAB OUT OF TOLERANCE DATA AS FOUND

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found	♀	Uncertainty (k=2; ±)		TUR

Remarks:

Unit was received out of tolerance, verified and adjusted to meet manufacturer's specifications.

The reported uncertainty is the uncertainty of the calibration process.For measuring instruments add 0.6 of the least significant digit to the reported uncertainty to obtain the measurement uncertainty of the unit under test at the pecific test point.

Reported resolution of the UUT does not represent calibration uncertainty or accuracy of the UUT

Nozzle Calibration Sheet

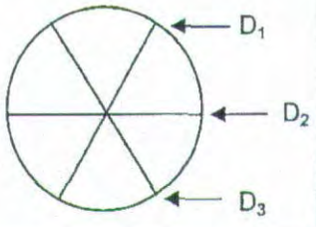
Client	Marathon	Project Number	12461
Calibrated by	SL	Caliper ID	
Date	3/18/14	Unit / Runs	All

Nozzle Identification	D_1 (inches)	D_2 (inches)	D_3 (inches)	ΔD (inches)	D_{ave} (inches)
250-1	0.250	0.250	0.250	0.000	0.250
276-1	0.276	0.276	0.276	0.000	0.276
275-1	0.275	0.275	0.275	0.000	0.275
235-1	0.235	0.235	0.235	0.000	0.235
235-2	0.235	0.236	0.235	0.001	0.235

D_1, D_2, D_3 = three nozzle diameter measurements

ΔD = maximum difference between any two diameters
$\Delta D \leq 0.004$ inches*

D_{ave} = average of D_1, D_2, D_3



* (40 CFR 60, Appendix A, Method 5, Section 5.1)

QA/QC SL
Date 3/18/14

CleanAir ENGINEERING

CDS005A-Nozzle.xls, August 2004
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AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott

Shipped From:
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TROY MI 48083
Phone: 248-589-2950 Fax: 248-589-2134

C E R T I F I C A T E O F A N A L Y S I S

AIR LIQUIDE

27 FORESTWOOD CT. UNIT A
ROMEOVILLE IL 60446
US

DOCUMENT#:48530081 -001
PO#: GEN. STOCK
ITEM #: 363-30AL
DATE: 13Nov2012

CYLINDER #: ALM054299
FILL PRESSURE: 02000 PSIG PRODUCT EXPIRATION: 14Nov2015

PURE MATERIAL: AIR CAS# 132259-10-0

GRADE: ZERO

IMPURITY	MAXIMUM CONCENTRATIONS	ACTUAL CONCENTRATIONS
THC	1 PPM	< 1 PPM
O2	20 TO 21%	= 20.9%

LOT# AIR103012

LOT # : TRO0069909

ANALYST: _____
ROBERT MCCRANDALL

AIR LIQUIDE Air Liquide America Specialty Gases LLC | Scott

RATA CLASS

Guaranteed +/- 1% Accuracy

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A22013
AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.: 60783-71-65000
Document # : 52145276-004

Customer
CLEAN AIR ENGINEERING
500 WEST WOOD STREET
PALATINE IL 60067
US

ANALYTICAL INFORMATION Gas Type : CO2,O2,BALN

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1, EPA/600/R-12/531; May 2012. Do not use this standard if pressure is less than 100 psig.

Cylinder Number: ALM023687 **Certification Date:** 02Oct2013 **Exp. Date:** 03Oct2021
Cylinder Pressure: 2000 PSIG **Batch No:** TRO0093276

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY (ABSOLUTE / RELATIVE)
OXYGEN	9.05 %	0.04 % / 0.4 %
CARBON DIOXIDE	9.14 %	0.1 % / 1.1 %
NITROGEN	BALANCE	

TRACEABILITY

REFERENCE STANDARD

COMPONENT	CONCENTRATION	UNCERTAINTY	CYLINDER	TYPE/SRM SAMPLE	EXP. DATE
OXYGEN	23.2000 %	0.0900 %	K024582	NTRM 2350	04Jan2018
CARBON DIOXIDE	4.9540 %	0.0250 %	K020778	NTRM 2000	25Nov2017

ANALYTICAL METHOD

1st Analysis: 01Oct2013

COMPONENT	INSTRUMENT	ANALYTICAL/PRINCIPLE	CALIBRATED	CONCENTRATION
OXYGEN	CAI/110P/V03018	PARAMAGNETIC	30Sep2013	9.050 %

1st Analysis: 02Oct2013

COMPONENT	INSTRUMENT	ANALYTICAL/PRINCIPLE	CALIBRATED	CONCENTRATION
CARBON DIOXIDE	PIR/2000/609015	NDIR	13Sep2013	9.140 %

Special Notes: DELIVERY DOC# 82144795

APPROVED BY: _____
JEFF CROTEAU

AIR LIQUIDE SPECIALTY GASES Scott

Download as...

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RATA CLASS

Dual-Analyzed Calibration Standard

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A22010
AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.: 58250-71-65000
Project No.: 05-89250-005

Customer
CLEAN AIR ENGINEERING
DON ALLEN
500 W. WOOD STREET
PALATINE IL 60067

ANALYTICAL INFORMATION Gas Type : OC2

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM051631 **Certification Date:** 11Jul2010 **Exp. Date:** 12Jul2018
Cylinder Pressure***: 2000 PSIG

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY**	TRACEABILITY
CARBON DIOXIDE	19.0 %	+/- 1%	Direct NIST and VSL
OXYGEN	4.54 %	+/- 1%	Direct NIST and VSL
NITROGEN	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 2300	01Nov2010	1D002807	23.04 %	CARBON DIOXIDE
NTRM 2350	01Dec2011	K016398	23.20 %	OXYGEN

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
PIR/2000/609015	13Jul2010	NDIR
CAI/110P/V03018	12Jul2010	PARAMAGNETIC

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis
CARBON DIOXIDE
Date: 13Jul2010 Response Unit: MV
Z1=0.00000 R1=100.0000 T1=90.03000
R2=100.0000 Z2=0.00000 T2=90.01000
Z3=0.00000 T3=90.03000 R3=100.0000
Avg. Concentration: 18.96 PPM
OXYGEN
Date: 13Jul2010 Response Unit: %
Z1=0.00000 R1=23.20000 T1=4.54000
R2=23.20000 Z2=0.00000 T2=4.53000
Z3=0.00000 T3=4.53000 R3=23.20000
Avg. Concentration: 4.539 %

Second Triad Analysis

Calibration Curve

Concentration=A+Bx+Cx2+Dx3+Ex4

Constants: A=
B= C=
D= E=

Concentration=A+Bx+Cx2+Dx3+Ex4
r=0.999999
Constants: A=-0.00181762
B=1.001584599 C=0
D=0 E=0

Special Notes:
The expiration date has been extended without re-assay per EPA 600/R23-23/542.

QUALITY ASSURANCE

APPROVED BY: SARAH HERBERT
(signature on file)

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TROY MI 48083
Phone: 248-589-2950 Fax: 248-589-2134

C E R T I F I C A T E O F A N A L Y S I S

AIR LIQUIDE

27 FORESTWOOD CT. UNIT A
ROMEOVILLE IL 60446
US

DOCUMENT#:51976924 -002
PO#: GEN. STOCK
ITEM #: 763-30AL
DATE: 29Aug2013

CYLINDER #: ALM010791
FILL PRESSURE: 02000 PSIG

PURE MATERIAL: NITROGEN CAS# 7727-37-9

GRADE: ZERO GAS

PURITY: 99.998%

IMPURITY	MAXIMUM CONCENTRATIONS	ACTUAL CONCENTRATIONS
THC	0.5 PPM	< 0.5 PPM

QC BATCH: NITFILL082813

LOT # : TRO0091367

ANALYST: _____
SAJAD HYDER

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RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No:: 58320-71-65000
Project No.: 05-90126-010

Customer

CLEAN AIR ENGINEERING
DON ALLEN
500 W. WOOD STREET
PALATINE IL 60067

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM025456 Certification Date: 09Aug2010 Exp. Date: 08Aug2013
Cylinder Pressure***: 1900 PSIG

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
PROPANE	24.7	PPM	+/- 1%	Direct NIST and VSL
AIR		BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1668	02Oct2012	ALM029313	98.80 PPM	PROPANE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
VARIAN/3400/7506	21Jul2010	TCD/FID

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis

PROPANE
Date: 09Aug2010 Response Unit:AREA
Z1=0.00000 R1=2622160. T1=657219.0
R2=2622754. Z2=0.00000 T2=655938.0
Z3=0.00000 T3=655843.0 R3=2634150.
Avg. Concentration: 24.70 PPM

Second Triad Analysis

Calibration Curve

Concentration = A+Bx+Cx2+Dx3+Ex4
r=1.000000
Constants: A=-0.03187273
B=3.73069E-05 C=0
D=0 E=0

APPROVED BY: ROBERT LESNIAK

AIR LIQUIDE Air Liquide America Specialty Gases LLC

Scott

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.: 59092-71-65000
Document # : 42679778-018

Customer
CLEAN AIR ENGINEERING

DON ALLEN
500 WEST WOOD STREET
PALATINE IL 60067
US

ANALYTICAL INFORMATION Gas Type : NONE

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: AL1816
Cylinder Pressure***: 2015 PSIG
Certification Date: 15Aug2011
Exp. Date: 14Aug2014
Batch No: TRO0039665

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY**	TRACEABILITY
PROPANE	45.4 PPM	+/- 1%	
AIR	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1668	02Oct2013	ALM008717	99.50 PPM	PROPANE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
VARIAN/3400/7506	12Aug2011	TCD/FID

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis

PROPANE
Date: 15Aug2011 Response Unit: AREA
Z1=0.00000 R1=2618719. T1=1194617.
R2=2617638. Z2=0.00000 T2=1192626.
Z3=0.00000 T3=1192402. R3=2630399.
Avg. Concentration: 45.37 PPM

Second Triad Analysis

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 0.999997
Constants: A=0.054408
B=0.000037 C=0.000000
D=0.000000 E=0.000000

APPROVED BY: _____
ROBERT MCCRANDALL

AIR LIQUIDE Air Liquide America Specialty Gases LLC

Scott™

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A22012

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.: 60162-71-65000
Document # : 48726193-004

Customer
CLEAN AIR ENGINEERING

500 WEST WOOD STREET
PALATINE IL 60067
US

ANALYTICAL INFORMATION Gas Type : NONE

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM010763 **Certification Date:** 26Dec2012 **Exp. Date:** 26Dec2020
Cylinder Pressure*:** 2000 PSIG **Batch No:** TRO0072086

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY**	TRACEABILITY
PROPANE	85.6 PPM	+/- 1%	Direct NIST and VSL
AIR	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.

** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1668	12Jul2018	ALM038653	98.80 PPM	PROPANE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
VARIAN/3400/7506	20Dec2012	TCD/FID

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

First Triad Analysis

PROPANE

Date: 24Dec2012 Response Unit: AREA
Z1 = 0.00000 R1 = 2599145. T1 = 2242571.
R2 = 2583011. Z2 = 0.00000 T2 = 2238784.
Z3 = 0.00000 T3 = 2238540. R3 = 2582421.
Avg. Concentration: 85.58 PPM

Second Triad Analysis

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 0.999998
Constants: A = -0.02622038
B = 3.80676E-05 C = 0
D = 0 E = 0

APPROVED BY: JEFF CROTEAU

FIELD DATA

E

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: RWK

Date: 05/14

CleanAir

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FPM/CPM

TEST LOCATION: Stack ~~MB/202~~ ML 3/18 TESTING METHOD: 5/202 PAGE 1 OF 2

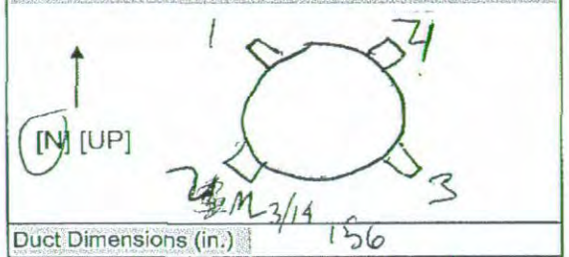
UNIT: FCC Regenerator/ent RUN: 1

FIELD DATA SHEET

Client	Marathon	Project No.	1246 1
Plant	Garyville, LA	Date	3-18-14
Meter Operator	M LeRescher		
Probe Operator	T. A. Christensen		

Meter Box	66-24	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.68	Pitot C_p	0.831
Leak Rate Before	.002 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.001 [cfm] [Lpm]	@	12 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☑ Bad ☐		

Cross-Section of Test Location



Duct Dimensions (in.) 156

Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	63	Bar. Press.	29.76 [in. Hg] [mbar]
Probe I.D. No.	M ~~[illegible]~~ 67-6-1		
Liner Material	3/18 Glass		

Filter No.	45472		
Thimble No.	N/A		
Nozzle Diameter	0.276	Nozzle I.D.	276-1

Start Time: 10:45 Stop Time: 12:01

Traverse Point Number	Min/pt 25 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L] 521.467	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☒ Amb Filter ☐ Dioxin Trap ☐	Notes
2-1	2:30	0.4	1.47	522.08	144	242	256	56	64	64	3.5	1.7	68	ML
2	5:00	0.4	1.47	524.68	144	241	254	54	64	64	3.5	1.7	68	3/18
3	7:30	0.4	1.47	526.39	144	240	255	53	65	64	3.5	1.7	68	
4	10:00	0.4	1.47	527.84	143	244	259	51	68	63	3.5	1.9	68	
5	12:30	0.35	1.28	529.35	143	243	258	51	70	64	3.5	1.5	68	
6	15:00	0.28	1.03	~~530.791~~ 530.791 ML 3/18	143	240	258	51	72	64	3.5	1.3	68	530.791
1-1	17:30	0.4	1.47	532.29	144	233	258	52	73	66	4	2.3	68	
2	20:00	0.4	1.47	533.96	143	239	260	51	74	66	4	2.1	68	
3	22:30	0.4	1.47	535.40	144	244	260	50	76	66	4	1.6	68	
4	25:00	0.37	1.36	536.84	144	244	258	49	78	67	4	1.5	72	
5	27:30	0.3	1.10	538.24	144	243	257	50	79	67	4	1.4	78	
6	30:00	0.28	1.03	539.541	143	240	257	50	79	68	4	1.7	79	
	Total	7.2381	16.09	18.074	1723				862	783				
	Average	.6028												

* Sum of square roots.

Circle correct bracketed units on data sheet.

CleanAir ENGINEERING

QA/QC SL
Date 4/29/14

FDS005-General.xls, December 2006
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TEST LOCATION: Stack FPM/CPM **TESTING** **METHOD:** 5/202 **PAGE** 2 **OF** 2

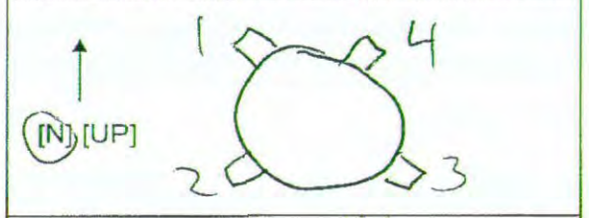
UNIT: FCC Regenerator Vent **RUN:** 1

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	5-18-14
Meter Operator	M. LeResche		
Probe Operator	A. Christensen		

Meter Box	66-24	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.68	Pitot C_p	0.831
Leak Rate Before	.002 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	.001 [cfm] [Lpm]	@	12 (in. Hg)
Pitot Leak Check Before: ☒		After: Good ☒ Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	156		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
.2	9.25		

Amb. Temp. (°F)	63	Bar. Press.	29.76 [in. Hg] [mbar]
Probe I.D. No.	67-61		
Liner Material	Glass		

Filter No.	45472		
Thimble No.	N/A		
Nozzle Diameter	0.276	Nozzle I.D.	276-1

Start Time:	10:45	Stop Time:	12:01

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L] 539.541	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☒ Amb Filter ☐ Dioxin Trap ☐	Notes
4-1	32:30	0.4	1.47	541.13	144	238	257	52	76	68	4.5	1.6	71	
2	35:00	0.4	1.47	542.76	144	242	259	52	78	68	4.5	1.4	68	
3	37:30	0.4	1.47	544.39	145	248	259	53	80	69	4.5	1.3	68	
4	40:00	0.37	1.36	546.00	145	251	246	53	81	69	4.5	1.3	68	
5	~~45~~ 42:30 M 3/18	0.30	1.10	547.52	145	250	252	54	82	69	4.5	1.4	68	
6	45:00	0.26	0.9568	548.912	145	252	250	55	81	69	4.5	1.7	72	
3-1	47:30	0.4	1.47	550.58	145	248	247	61	76	70	4.5	1.6	75	
2	50:00	0.42	1.55	552.16	145	250	253	59	79	70	4.5	1.6	77	
3	52:30	0.42	1.55	553.86	145	250	252	58	81	70	5	1.5	81	
4	55:00	0.45	1.66	555.57	145	250	247	58	82	70	5.5	1.5	83	
5	57:30	0.4	1.47	557.31	145	244	252	58	83	71	5.5	1.7	83	
6	60:00	0.3	1.10	558.885	144	242	249	60	84	71	5	1.9	82	
	Total	7.3429	16.63	37.418	1737				963	834				
	Average	.6074	1.3633		144.1667				73.8083					

Sum of square roots. M 3/19
0.6073
DM 3/27

Circle correct bracketed units on data sheet. M 3/19

M 3/19
71.70833
DM 3/27

QA/QC M
Date 3/19

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FDS005-General.xls, December 2006
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TEST LOCATION: Stack FPM/CPM TESTING METHOD: 5/202 PAGE 1 OF 2

UNIT: FCC Regenerator RUN: 2

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-18-14
Meter Operator	M. LeRosche		
Probe Operator	A. Christiansen		

Meter Box	66-24	Sample Box No.	FB-2
Meter Y_d	0.993	Meter $\Delta H_@$	1.746
K Factor	3.638	Pitot C_p	0.831
Leak Rate Before	0.001 [cfm] [Lpm]	@	6 (in. Hg)
Leak Rate After	0.001 [cfm] [Lpm]	@	11 (in. Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐		

Cross-Section of Test Location

Duct Dimensions (in.) 156

Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25	[Out]	[In]

Amb. Temp. (°F)	68	Bar. Press.	29.76 [in. Hg] [mbar]
Probe I.D. No.	C7-6-1		
Liner Material	Glass		

Filter No.	45473		
Thimble No.	N/A		
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	17:56	Stop Time:	19:00

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. 559.509 (ft³) [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☒ Amb Filter ☐ Dioxin Trap ☐ ____	Notes
#3-1	2:30	0.41	1.48	561.27	144	252	247	51	77	78	3.5	2.1	68	
3/18 2	5:00	0.41	1.46	562.98	144	253	249	49	78	78	3.5	1.4	68	
3	7:30	0.42	1.52	564.66	144	254	244	47	76	77	3.5	1.4	69	
4	10:00	0.4	1.45	566.33	144	255	243	46	77	77	3.5	1.4	69	
5	12:30	0.34	1.23	567.94	144	256	246	46	77	76	3.5	1.4	78	
6	15:00	0.3	1.09	569.472	144	246	241	47	77	75	3.5	1.3	83	
4-1	17:50	0.4	1.45	571.10	144	255	254	53	75	75	3.5	1.6	79	
2	20:00	0.4	1.45	572.77	144	253	255	49	77	75	4	1.4	83	
3	22:50	0.4	1.45	574.416	144	251	253	48	79	74	4	1.6	83	
4	25:00	0.37	1.34	576.17	144	251	256	49	79	74	4	1.5	83	
5	27:30	0.3	1.09	577.39	144	249	251	50	81	74	3.5	1.3	83	
6	20:00	0.25	0.90	579.085	143	250	252	50	81	74			83	
	Total	7.2453	15.94		1727				933	907				
	Average	1.0078												

* Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC M

Date 3/19

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TEST LOCATION: Stack EPM/CPM TESTING METHOD: 5/202 PAGE 2 OF 2

UNIT: FCC Regenerator Vent RUN: 2

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-18-14
Meter Operator	M. LeRoche		
Probe Operator			

Meter Box	66-24	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.6483	Pitot C_p	0.881
Leak Rate Before	.002 [cfm] [Lpm] @	16	(in. Hg)
Leak Rate After	.000 [cfm] [Lpm] @	11	(in. Hg)
Pitot Leak Check Before: ☐	After: Good ☒ Bad ☐		

Cross-Section of Test Location

Duct Dimensions (in.)	156

Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25	[Out]	[In]

Amb. Temp. (°F)	68	Bar. Press.	29.76 [in. Hg] [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	45473		
Thimble No.	N/A		
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	17:56	Stop Time:	19:09

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. 559.509 (ft^3) [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☒ Amb Filter ☐ Dioxin Trap ☐	Notes
1-1	32:30	0.4	1.45	580.74	145	251	255	56	76	74	3	1.5	75	
2	35:00	0.41	1.48	582.09	144	249	249	53	78	74	3	1.5	76	
3	37:30	0.42	1.52	584.14	145	249	251	52	80	74	3.5	1.3	78	
4	40:00	0.37	1.34	585.81	145	251	258	52	82	74	3.5	1.2	79	
5	42:30	0.3	1.09	587.37	144	250	248	53	82	74	3.5	1.3	82	
6	45:00	0.27	0.981	588.805	144	249	243	54	81	74	3.5	1.5	80	
2-1	47:30	0.4	1.45	590.49	145	248	254	55	75	76	3.5	1.6	68	
2	50:00	0.4	1.45	592.17	145	251	248	52	78	73	3.5	1.4	70	
3	52:30	0.4	1.45	593.85	145	253	254	52	79	73	3.5	1.6	73	
4	55:00	0.39	1.47	595.57	145	253	255	52	80	73	3.5	1.4	75	
5	57:30	0.33	1.12	597.16	145	254	251	52	81	73	3.5	1.3	75	
6	60:00	0.25	0.91	598.545	145	250	246	52	80	73	3.5	1.3	76	
	Total	7.193	15.66	39.036	1737				952	886				
	Average	.6016		M 3/18	145					76.604				

Sum of square roots 1.3167

Circle correct bracketed units on data sheet. 144.3333 M 3/18

QA/QC M Date 3/19

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TEST LOCATION: Stack FPM/CPM **TESTING** **METHOD:** 5/202 **PAGE** 1 **OF** 2

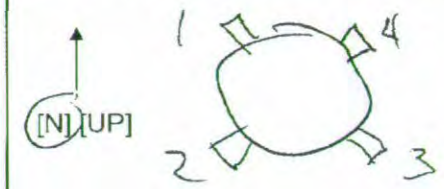
UNIT: FCC Regenerator Vent **RUN:** 3

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	M. LeResche		
Probe Operator	A. Christiansen		

Meter Box	66-24	Sample Box No.	EB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.2476
K Factor	3.68 3.63	Pitot C_p	0.831
Leak Rate Before	0.004 [cfm] [Lpm]	@	16 (in. Hg)
Leak Rate After	0.001 [cfm] [Lpm]	@	11 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.):	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25	[Out]	[In]

Amb. Temp. (°F)	67	Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	G7-G-1		
Liner Material	Glass		

Filter No.	464-1		
Thimble No.	—	N/A	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	9:14	Stop Time:	10:23

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. 598.953 [ft^3] [L] M 3/19	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☒ Amb Filter ☐ Dioxin Trap ☐	Notes
2-1	2:30	0.4	1.45	600.84	144	252	252	66	66	65	6.5	1.6	65	
2	5:00	0.4	1.45	602.49	144	252	254	61	68	65	6.5	1.7	65	
3	7:30	0.4	1.45	604.07	144	251	250	58	70	65	6.5	1.6	66	
4	10:00	0.34	1.36	605.62	144	249	251	57	69	64	6.5	1.3	68	
5	12:30	0.32	1.16	607.27	144	249	249	56	70	64	6.5	1.4	71	
6	15:00	0.27	0.98	608.701	143	249	250	54	68	63	6	1.5	73	
1-1	17:30	0.42	1.52	610.38	144	241	249	52	63	61	7	1.4	69	
2	20:00	0.43	1.56	612.07	145	244	249	50	65	62	7	1.6	70	
3	22:30	0.42	1.52	613.67	145	250	253	48	66	62	7	1.3	73	
4	25:00	0.34	1.38	615.21	145	251	251	48	66	62	7.5	1.7	76	
5	27:30	0.32	1.16	616.98	144	251	253	49	66	61	7.5	1.4	77	
6	30:00	0.28	1.02	618.396	144	253	251	48	67	61	7	1.3	78	
	Total	16.100			1730				804	755				
	Average	.6052												

Sum of square roots. 7.2623 ML 3/19

Circle correct bracketed units on data sheet.

QA/QC [illegible] Date 4/7/14

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TEST LOCATION: Stack FBM/CPM TESTING METHOD: 5/202 PAGE 2 OF 2

UNIT: FCC Regenerator Vent RUN: 3

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-18-14
Meter Operator	M. LeRoche		
Probe Operator	A. Christiansen		

Meter Box	GC-24	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	~~3.63~~ 3.64	Pitot C_p	0.831
Leak Rate Before	0.01 [cfm] [Lpm] @	15	(in. Hg)
Leak Rate After	0.00 [cfm] [Lpm] @	11	(in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒ Bad ☐		

Cross-Section of Test Location

Duct Dimensions (in.)	156		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	67	Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	454-1		
Thimble No.	N/A	—	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	9:14	Stop Time:	10:43

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft^3] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☑ Amb Filter ☐ Dioxin Trap ☐	Notes
				~~598.79~~ 598.953 M 3/19		250	250							
4-1	32:30	0.41	1.49	619.99	145	252	254	53	67	67	6	2	76	
2	35:00	0.41	1.49	621.65	145	250	250	49	73	63	8.5	1.3	83	
3	37:30	0.41	1.49	623.41	145	249	290	49	~~M 3/18~~ 73	63	8.5	1.5	83	
4	~~30~~:00	0.38	1.38	625.00	145	250	252	50	77	65	8.5	1.3	76	
5	42:30	0.32	1.16	626.57	145	253	254	50	80	65	8	1.2	72	
6	45:00	0.26	0.94	627.978	143	252	254	52	82	67	7	1.3	70	
3-1	47:30	0.42	1.52	629.64	145	246	251	57	77	69	8	1.5	70	
2	50:00	0.42	1.52	631.37	145	249	252	52	83	70	8	1.4	69	
3	52:30	0.42	1.52	633.02	145	251	252	50	84	71	8	1.6	71	
4	55:00	0.4	1.45	634.69	145	252	253	50	85	72	8	1.2	75	
5	57:30	0.31	1.13	636.25	145	249	251	51	86	73	7.5	1.4	78	
6	60:00	0.26	0.94	637.647	144	246	249	52	85	73	7.5	1.4	78	
	Total	7.363	16.03	38.694	1737				954	813				
	Average	~~1.6048~~ 1.3358	~~3.346~~		~~144.45~~ 144.783				79.2916					

Sum of square roots. 1.3358 DM 3/27

Circle correct bracketed units on data sheet.

QA/QC M

Date 3/14

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TEST LOCATION: Stack **FPM/CPM TESTING** **METHOD:** 5/202 **PAGE** 1 **OF** 2

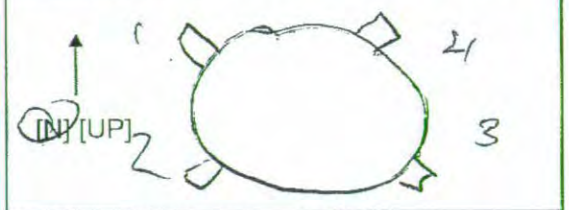
UNIT: FCC Regenerator Vent **RUN:** 4

FIELD DATA SHEET

Client	Marathon	Project No.	17461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	M LaRoche		
Probe Operator	A Christiansen		

Meter Box	66-24	Sample Box No.	ICRT
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.13	Pitot C_p	0.831
Leak Rate Before	0 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.001 [cfm] [Lpm]	@	11 (in. Hg)
Pitot Leak Check Before: ☑	After: Good ☑	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	156		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
.2	9.25		

Amb. Temp. (°F)	67	Bar. Press.	29.95 [in. Hg] [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	45475		
Thimble No.	—	N/A	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	11:23	Stop Time:	12:32

Traverse Point Number	Min/pt / Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%dv)	☑ Amb Filter ☐ Dioxin Trap ☐	Notes
				639.373		250	250							
3-1	2:30	0.4	1.45	641.39	145	246	259	68	75	74	4	2.1	69	
2	5:00	0.34	1.23	642.66	146	248	259	66	78	75	3.5	1.9	68	
3	7:30	0.45	1.63	644.74	146	248	250	65	80	75	4	2.0	68	
4	10:00	1.44	1.60	646.51	146	249	254	63	84	75	4	1.9	68	
5	12:30	0.33	1.20	648.10	146	249	251	62	86	76	3.5	1.7	69	
6	15:00	0.26	0.94	649.525	145	249	251	61	86	76	3	2.3	71	
4-1	17:30	0.4	1.45	651.22	145	253	252	62	81	76	3.5	2.1	71	
2	20:00	0.4	1.45	652.88	145	254	254	59	84	76	4	1.8	77	
3	22:30	0.4	1.45	654.54	145	253	252	58	84	76	4	1.8	81	
4	25:00	0.37	1.34	656.18	144	251	251	58	84	76	4.5	1.7	83	
5	27:30	0.30	1.09	657.72	144	254	257	58	83	75	3.5	1.7	83	
6	30:00	0.35	1.27	659.279	143	250	250	57	82	75	3.5	2.1	81	
	Total	7.279	16.1		1741				987	905				
	Average	0.6066			1740									

* Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC SL
Date 4/23/14

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TEST LOCATION: Stack FPM/CPM **TESTING** **METHOD:** 5/202 **PAGE** 2 **OF** 2

UNIT: FCC Regenerator Vent **RUN:** 4

FIELD DATA SHEET

Client	Marathon	Project No.	17461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	M LeRosche		
Probe Operator	A Christiansen		

Meter Box	66-24	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	17476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.001 [cfm] [Lpm]	@	11 (in. Hg)
Pitot Leak Check Before: ☒		After: Good ☒ Bad ☐	

Cross-Section of Test Location

Duct Dimensions (in.)	156		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	69	Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	45475		
Thimble No.			
Nozzle Diameter	0.275	Nozzle I.D.	275-1
Start Time:	11:23	Stop Time:	12:32

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L] 639.323	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☒ Amb Filter ☐ Dioxin Trap ☐	Notes
1-1	32:30	0.4	1.45	661.04	143	244	246	61	77	74	4	2.1	77	
2	35:00	0.4	1.45	662.75	144	246	246	58	80	75	4	1.9	73	
3	37:30	0.4	1.45	664.44	144	246	247	57	81	75	4	2	72	
4	40:00	0.4	1.45	666.14	144	247	250	56	83	75	4	2.2	~~85~~ 73	ML 3/19
5	42:30	0.34	1.23	667.74	144	248	251	56	83	75	4	2.4	74	
6	45:00	0.34	1.38	669.343	144	249	246	56	84	75	4	2.1	76	
2-1	47:30	0.4	1.45	671.03	145	249	253	60	80	75	4	2.3	75	
2	50:00	0.35	1.27	672.68	145	251	251	58	83	76	4	1.7	78	
3	52:30	0.44	1.60	674.41	145	251	252	58	86	76	4	1.8	81	
4	55:00	0.44	1.60	676.22	145	252	252	57	87	76	4	1.7	83	
5	57:30	0.37	1.34	677.92	145	252	245	53	88	77	4	1.9	79	
6	60:00	0.33	1.20	679.530	145	249	249	50	88	78	3.5	2.5	70	
	Total	8.8303	16.87	40.2070	1733				1000	907				
	Average	~~0.7352~~	1.3738	DM 3/28	144.7510				79.1458					

* Sum of square roots.

Circle correct bracketed units on data sheet.

ML 3/19 ~~0.6713~~ .6344 DM 3/28

144.70633 DM 3/28

79.1458 DM 3/28

QA/QC ML

Date 3/19

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TEST LOCATION: Stack FPM/CPM TESTING METHOD: 5/202 PAGE 1 OF 2

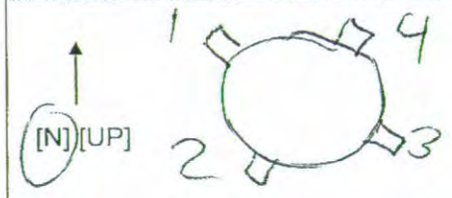
UNIT: FCC Regenerator Vent RUN: 5

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	M LeRoche		
Probe Operator	A Christiansen		

Meter Box	66-2	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	.002 (cfm) [Lpm]	@	15 (in. Hg)
Leak Rate After	.001 (cfm) [Lpm]	@	9 (in. Hg)
Pitot Leak Check Before: ☑	After: Good ☐ Bad ☐		

Cross-Section of Test Location



Duct Dimensions (in.)	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] (Out) of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	74	Bar. Press.	29.96 (in. Hg) [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	45476		
Thimble No.	—	N/A	—
Nozzle Diameter	.275	Nozzle I.D.	275-1

Start Time:	13:47	Stop Time:	1438

Traverse Point Number	Min/pt / Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%;dv)	☒ Amb Filter ☐ Dioxin Trap ☐	Notes
				679.855		250	250							
2-1	2:30	0.4	1.45	681.58	144	251	255	58	75	74	4	2.2	74	
2	5:00	0.4	1.45	683.26	144	251	256	61	77	75	4	1.5	81	
3	7:30	0.39	1.42	684.95	144	253	255	58	81	75	4	1.6	83	
4	10:00	0.4	1.45	686.67	145	252	254	57	83	78	4	1.4	83	
5	17:30	0.31	1.13	688.22	144	249	249	56	83	75	4	1.6	77	
6	15:00	0.31	1.13	689.734	145	250	252	57	84	76	3.5	1.6	73	
1-1	17:30	0.4	1.45	691.41	145	249	249	65	82	77	3.5	1.6	73	
2	20:00	0.42	1.52	693.15	145	248	252	60	84	77	3.5	1.6	71	
3	22:30	0.42	1.52	694.91	145	250	253	59	86	78	3.5	1.5	71	
4	25:00	0.30	1.09	696.57	144	251	251	58	87	78	3	1.9	71	
5	27:30	0.26	0.94	697.98	144	250	250	58	87	79	3	1.7	73	
6	30:00	0.26	0.94	699.340	144	248	250	58	86	78	3	1.8	74	
	Total	*7.135	15.49		1733				995	917				
	Average	.5943												

*Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC AL
Date 4/7/14

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TEST LOCATION: Stack FPM/CPM TESTING METHOD: 5/202 PAGE 2 OF 2

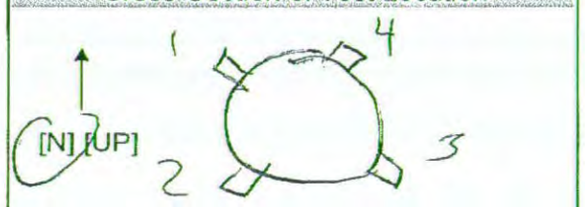
UNIT: ACC Regenerator Vent RUN: 5

FIELD DATA SHEET

Client	Marathon	Project No.	17461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	M Lebouzhe		
Probe Operator	A Christensen		

Meter Box	66-24	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7176
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	.00 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	[cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐		

Cross-Section of Test Location



Duct Dimensions (in.)

Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)		Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	45476		
Thimble No.			
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time: 13:47 Stop Time:

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. 679.835 [ft^3] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☒ Amb Filter ☐ Dioxin Trap ☐	Notes
4-1	32:30	0.42	1.52	701.65	145	248	250	65	84	79	4	1.9	78	
2	35:00	0.42	1.52	702.79	145	246	249	57	86	79	4	2.2	75	
3	37:30	0.42	1.52	704.54	145	250	251	52	88	80	4	2.7	71	
4	40:00	0.42	1.52	706.29	144	251	251	50	90	80	4	2.5	71	
5	42:30	0.35	1.27	708.00	144	251	251	49	92	90	4	2.5	74	
6	45:00	0.35	1.27	709.603	145	249	250	49	93	81	3.5	1.9	76	
3-1	47:30	0.41	1.49	711.20	145	249	250	52	85	92	3.5	1.8	79	
2	50:00	0.42	1.52	712.89	145	250	251	55	88	82	3.5	1.7	83	
3	52:30	0.42	1.52	714.65	145	249	248	54	88	82	4	2	75	
4	55:00	0.39	1.42	716.38	145	247	234	53	88	82	4	2	71	
5	57:30	0.34	1.23	718.07	145	247	257	54	82	81	4	2	68	
6	60:00	0.27	0.98	719.485	145	250	255	54	87	82	4	2.1	68	
	Total	7.4392	6.78	39.6500	1738				1056	970				
	Average	0.6071	1.3446	DM 3/28	144.6250					82.0417				

Sum of square roots. Circle correct bracketed units on data sheet.

QA/QC M
Date 2/19

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TEST LOCATION: Stack FPM/CPM TESTING METHOD: 5/202 PAGE 1 OF 2

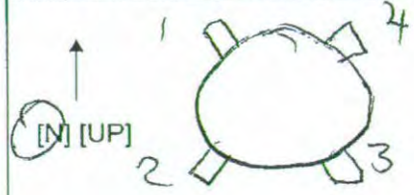
UNIT: FCC Regenerator Vent RUN: 6

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	M. LeRoche		
Probe Operator	A. Christiansen		

Meter Box	G6-24	Sample Box No.	FB-7
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.603	Pitot C_p	0.831
Leak Rate Before	0.002 [cfm] [Lpm]	@	16 (in. Hg)
Leak Rate After	0.001 [cfm] [Lpm]	@	10 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☑ Bad ☐		

Cross-Section of Test Location



Duct Dimensions (in.) 150

Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	76	Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	4547		
Thimble No.	NA		
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	1531	Stop Time:	1641

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. 719.655 [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☒ Amb Filter ☐ Dioxin Trap ☐	Notes
3-1	2:30	0.4	1.45	721.38	144	252	252	58	83	82	04	1.4	73	
2	5:00	0.4	1.45	723.10	144	254	253	64	87	83	04	1.4	74	
3	7:30	0.4	1.45	724.79	145	253	251	60	90	84	4	1.4	77	
4	10:00	0.4	1.45	726.50	144	248	249	56	92	84	4	1.4	78	
5	12:30	0.33	1.20	728.11	144	248	250	55	91	85	4	1.5	80	
6	15:00	0.33	1.20	729.651	144	249	253	56	91	85	4	1.7	81	
4-1	17:30	0.38	1.35	731.28	144	249	249	68	88	86	4.5	1.6	83	
2	20:00	0.4	1.45	732.98	144	249	248	57	90	86	4.5	1.6	83	
3	22:30	0.38	1.36	734.67	144	249	247	52	89	85	4.5	1.4	79	
4	25:00	0.35	1.27	736.29	144	249	250	50	90	85	4.5	1.7	76	
5	27:30	0.25	0.91	737.64	144	249	248	50	91	85	4	2	27	
6	30:00	0.25	0.91	739.036	144	248	250	51	90	85	4	1.9	78	
	Total	*7.1357	15.5		1729				1072	1015				
	Average	0.5946												

* Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC M
Date 3/19

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TEST LOCATION: Stack FPM / CPM **TESTING** **METHOD:** 5/202 **PAGE** 2 **OF** 2

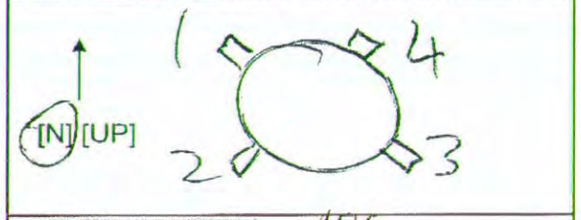
UNIT: FCC Regenerator Vent **RUN:** 6

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	M LeResche		
Probe Operator	A Christiansen		

Meter Box	66-74	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	.02 [cfm] [Lpm]	@	16 (in. Hg)
Leak Rate After	[cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☒	After: Good ☐ Bad ☐		

Cross-Section of Test Location



Duct Dimensions (in.)	156		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.75		

Amb. Temp. (°F)	76	Bar. Press.	29.96 (in. Hg) [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	45477		
Thimble No.	N/A		
Nozzle Diameter	0.275	Nozzle I.D.	67-1

Start Time:	15:31	Stop Time:	

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. 6 [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☒ Amb Filter ☐ Dioxin Trap ☐	Notes
				719.655		250	250							
1-1	32:30	0.38	1.38	740.76	144	248	252	56	87	85	4	1.9	78	
2	35:00	0.4	1.45	742.40	145	249	251	52	89	85	4	1.8	76	
3	37:30	0.42	1.52	744.14	145	250	249	50	90	85	4	1.6	74	
4	40:00	0.36	1.30	745.79	145	250	250	50	89	85	4	1.8	73	
5	42:30	0.30	1.09	747.37	144	249	249	50	89	87	4	1.9	73	
6	45:00	0.27	0.98	748.746	144	249	250	50	87	84	4	2.1	73	
2-1	47:30	0.38	1.38	750.33	144	247	252	59	85	84	4	4	75	
2	50:00	0.4	1.45	752.03	145	250	251	51	89	84	4	2	76	
3	52:30	0.4	1.45	753.78	144	252	251	49	90	84	5	2	76	
4	55:00	0.36	1.30	755.44	144	249	250	48	92	84	4.5	2.2	79	
5	57:30	0.36	1.30	757.05	144	247	249	49	91	84	4.5	2.2	80	
6	60:00	0.30	1.09	758.568	144	247	250	56	91	84	4	2.2	81	
	Total	7.1934	15.64	38.9130	1732				1071	1015				
	Average	0.5917	1.2946	Dm 3/28	144.2083					86.9375				

Sum of square roots 1.29833 Dm 3/28

Circle correct bracketed units on data sheet.

QA/QC M

Date 3/19

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TEST LOCATION: FCC Stack H_2SO_4 TESTING METHOD: 8 PAGE 1 OF 2

UNIT: Regenerator-Vent RUN: 1

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-20-14
Meter Operator	M LaRoche		
Probe Operator	A Christiansen		

Cross-Section of Test Location

Amb. Temp. (°F)	68	Bar. Press.	29.96 [in. Hg], [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Meter Box	66-24	Sample Box No.	~~FB5~~ M7 M3/10
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.002 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.002 [cfm] [Lpm]	@	12 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒ Bad ☐		

Filter No.	—	N/A	—
Thimble No.	—	N/A	—
Nozzle Diameter	.275	Nozzle I.D.	275-1

Duct Dimensions (in.)	156		
Static Pres ($in. H_2O$)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.75		[In]

Start Time:	9:31	Stop Time:	10:50

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP ($in. H_2O$)	Orifice Setting ΔH ($in. H_2O$)	Gas Sample Volume V_m Init. Vol. [ft^3] [L] 758.786	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ DioxIn Trap ☒ Imp 5	Notes
2-1	2:30	0.4	1.45	760.56	144	~~252~~	254	60	70	69	6.5	1.6	68	
2	5:00	0.4	1.45	762.11	144	251	25	55	72	69	6.5	1.5	~~78~~	
3	7:30	0.38	1.38	763.74	144	249	248	53	74	69	6.5	1.5	94	
4	0:00	0.32	1.16	765.31	143	250	251	53	74	69	5	2	97	
5	2:30	0.27	0.98	766.77	143	248	251	55	75	69	4	1.8	97	
6	5:00	0.25	0.91	768.115	143	251	252	59	75	69	3.5	1.6	97	
1-1	7:30	0.4	1.45	769.63	143	246	245	64	70	68	6.5	2.1	86	
2	0:00	0.4	1.45	771.28	144	249	250	63	75	69	7	1.8	~~85~~	
3	2:30	0.38	1.38	772.93	144	248	249	65	75	69	6.5	1.8	91	
4	5:00	0.38	1.38	774.53	143	252	253	68	77	69	7	1.9	96	
5	7:30	0.27	0.98	775.99	144	248	252	68	78	70	5.5	1.8	~~100~~	
6	0:00	0.27	0.96	777.497	144	251	253	68	79	70	5	1.7	99	
	Total	7.0037*	14.95		1723				894	829				
	Average	.5836												

* Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC SL
Date 4/17/14

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TEST LOCATION: Stack H_2SO_4 **TESTING** **METHOD:** 8 **PAGE** 2 **OF** 2

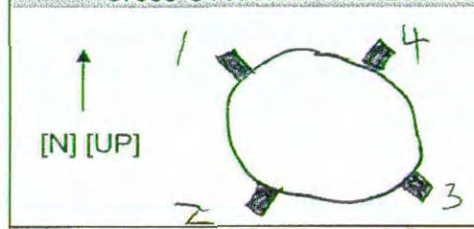
UNIT: FCC Regenerator Vent **RUN:** 1

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-20-14
Meter Operator		M LeResche	
Probe Operator		A Christiansen	

Meter Box	66-24	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.002 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.002 [cfm] [Lpm]	@	12 (in. Hg)
Pitot Leak Check Before:	☒	After: Good ☒	Bad ☐

Cross-Section of Test Location



Duct Dimensions (in.) 156

Static Pres ($in. H_2O$)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		[In]

Amb. Temp. (°F)		Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.		67-61	
Liner Material		Glass	

Filter No.	—	N/A	—
Thimble No.	—	N/A	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	9:31	Stop Time:	10:50

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP ($in. H_2O$)	Orifice Setting ΔH ($in. H_2O$)	Gas Sample Volume V_m Init. Vol. 758.786 [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☒ Imp 5	Notes
4-1	32:30	0.4	1.45	779.06	145	247	244	68	77	70	9.5	1.8	82	
2	35:00	0.4	1.45	780.76	144	241	242	68	79	71	10	2	79	
3	37:30	0.4	1.45	782.44	145	240	241	68	79	71	10	2	83	
4	40:00	0.37	1.34	784.10	145	238	246	68	79	71	9	1.5	86	
5	42:30	0.27	0.98	785.53	145	244	247	67	80	73	6.5	1.4	88	
6	45:00	0.24	0.87	786.851	144	244	245	66	80	71	5.5	1.9	86	
3-1	47:30	0.4	1.45	788.45	145	247	243	65	75	72	8	2.9	75	
2	50:00	0.49	1.78	790.19	145	247	244	63	79	73	9	1.3	72	1029 - 1039
3	52:30	0.4	1.45	791.91	145	245	242	63	76	72	7.5	1.6	68	
4	55:00	0.4	1.45	793.59	145	249	248	63	78	72	7.5	2.1	75	
5	57:30	0.38	1.38	795.24	145	251	247	65	79	73	7.5	1.9	80	
6	60:00	0.38	1.38	796.868	144			68	79	73			83	
	Total	7.348	16.43	38.0820	1737				940	862				
	Average	0.6121	1.3075		144.167				78.375					

Sum of square roots. 0.5979

Circle correct bracketed units on data sheet.

M 3/10

QA/QC M

Date 3/20

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TEST LOCATION: Stack FCC H_2SO_4 TESTING METHOD: 8 PAGE 1 OF 2

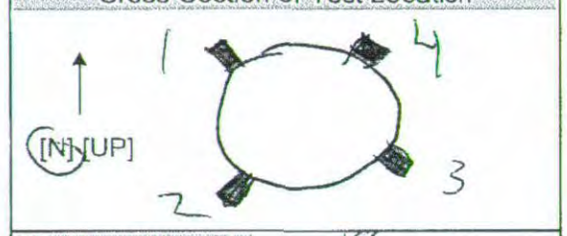
UNIT: Regenerator Vent RUN: 2

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-20-14
Meter Operator	MJ eResche		
Probe Operator	AChristiansen		

Meter Box	66-24	Sample Box No.	PB-2
Meter Y_d	0.9431	Meter $\Delta H_@$	1.7476
K Factor		Pitot C_p	0.831
Leak Rate Before	0.001 (cfm) [Lpm]	@	15 (in. Hg)
Leak Rate After	0.002 (cfm) [Lpm]	@	16 (in. Hg)
Pitot Leak Check Before:	☒	After: Good	☒ Bad ☐

Cross-Section of Test Location



Duct Dimensions (in.)	156		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] (Out) of page	First point all the way (In) [Out]
0.2	9.25		

Amb. Temp. (°F)	67	Bar. Press.	29.96 (in. Hg) [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	—	NA	—
Thimble No.	—	N/A	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	11:55	Stop Time:	1302

Traverse Point Number	Min/pt Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft³) [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☒ Imp 5	Notes
	2.5			797.125		250	250							
3-1	2:30	0.38	1.38	798.77	143	248	249	68	68	68	2.5	2	77	
2	5:00	0.4	1.45	800.42	144	250	249	68	68	68	3	1.7	95	
3	7:30	0.4	1.45	802.06	144	251	253	68	69	68	3	1.4	102	
4	10:00	0.3	1.09	803.56	144	253	256	68	71	66	3	1.4	107	
5	12:30	0.32	1.16	805.05	144	253	256	66	73	68	3	1.2	104	
6	15:00	0.25	0.91	806.491	144	253	251	67	75	68	3	1.6	105	
4-1	17:30	0.38	1.38	808.08	144	252	252	68	75	69	7	1.5	94	
2	20:00	0.4	1.45	809.78	144	250	252	68	77	70	7	1.6	97	
3	22:30	0.42	1.52	811.42	144	249	250	68	78	70	7	1.2	102	
4	25:00	0.4	1.45	813.10	144	248	248	68	79	70	6	1.4	107	
5	27:30	0.4	1.45	814.76	144	249	251	68	80	70	6	1.2	101	
6	30:00	0.42	1.52	816.476	144	246	250	68	80	71	6	1.5	97	
	Total	7.3047	16.21		1727				893	828				
	Average	0.6087												

* Sum of square roots.

Circle correct bracketed units on data sheet.

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Date 4/7/14

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TEST LOCATION: Stack H_2SO_4 TESTING METHOD: 8 PAGE 2 OF 2

UNIT: FCC Regenerator Unit RUN: 2

FIELD DATA SHEET

Client	Marathon	Project No.	12761
Plant	Garyville, LA	Date	3-20-14
Meter Operator	M. LaRoche		
Probe Operator	A. Christiansen		

Meter Box	66-24	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.001 (cfm) [Lpm]	@	15 (in. Hg)
Leak Rate After	0.002 (cfm) [Lpm]	@	16 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒ Bad ☐		

Cross-Section of Test Location

Duct Dimensions (in.): 156

Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] (Out) of page	First point all the way [In] [Out]
0.2	9.75		

Amb. Temp. (°F)	67	Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	G764		
Liner Material	Glass		

Filter No.	—	NA	—
Thimble No.	—	NA	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	11:55	Stop Time:	13:02

Traverse Point Number	Min/pt / Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. 797.125 [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☒ IMPS	Notes
1 - 1	32:30	0.38	1.38	818.107	144	249	249	66	78	71	15.5	1.6	85	
2	35:00	0.4	1.45	819.86	143	250	251	68	79	72	13	1.9	78	
3	37:30	0.42	1.52	821.66	144	248	249	67	80	72	10	2	87	
4	40:00	0.4	1.45	823.40	143	251	253	68	80	72	14	1.7	95	
5	42:30	0.38	1.38	825.12	143	251	250	66	80	72	13.5	2.1	95	
6	45:00	0.32	1.16	826.791	143	250	250	66	81	72	6	2.1	95	
2 - 1	47:30	0.38	1.38	828.28	144	251	252	67	79	72	8	2	82	
2	50:00	0.38	1.38	829.92	144	250	251	64	80	72	7	1.7	80	
3	52:30	0.38	1.38	831.62	143	249	250	59	82	73	6	2.3	82	
4	55:00	0.4	1.45	833.28	144	247	243	57	84	73	5.5	2.1	87	
5	57:30	0.32	1.16	834.85	144	248	250	57	84	74	5	1.9	88	
6	60:00	0.32	1.16	836.410	144	250	249	57	84	74	5	2	88	
	Total	7.3747	14.94	39.2850	1723				971	869				
	Average	0.6096	1.2981		143.7500				74.1875					

Sum of square roots

14.25 DM 3/28

1.30250 DM 3/28

Circle correct bracketed units on data sheet.

QA/QC M

Date 3/20

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TEST LOCATION: Stack H_2SO_4 TESTING METHOD: 8 PAGE 1 OF 2

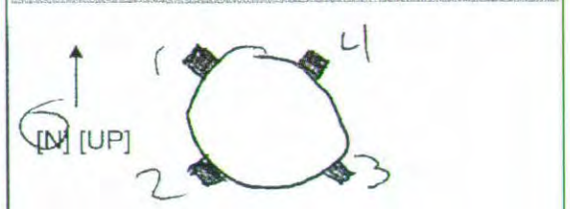
UNIT: FCC Regenerator Vent RUN: 3

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-20-14
Meter Operator	M LeRoche		
Probe Operator	A Christiansen		

Meter Box	66-24	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.001 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.000 [cfm] [Lpm]	@	17 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒ Bad ☐		

Cross-Section of Test Location



Duct Dimensions (in.)		150	
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow	First point all the way
6.2	9.75	[In] (Out) of page	(In) [Out]

Amb. Temp. (°F)	72	Bar. Press.	29.96 (in. Hg) [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	—	N/A	—
Thimble No.	—	N/A	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	13:26	Stop Time:	14:32

Traverse Point Number	Min/pt / Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft³) [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☒ Imps	Notes
	7.5			837.518		250	250							
2-1	2:30	0.38	1.38	839.07	144	254	249	68	76	74	5.5	2.4	74	
2	5:00	0.4	1.45	840.77	144	250	247	66	79	74	5.5	1.8	82	
3	7:30	0.4	1.45	842.44	144	249	249	59	79	74	6	2	96	
4	10:00	0.38	1.38	843.78	145	250	252	57	79	74	5.5	1.8	103	
5	12:30	0.3	1.09	845.64	144	251	252	59	80	73	5.5	2	104	
6	15:00	0.27	0.98	847.042	144	250	249	64	80	73	2.1	2	106	
1-1	17:30	0.4	1.45	848.54	144	250	246	68	80	74	6	2	94	
2	20:00	0.4	1.45	850.19	144	251	253	67	82	74	6.5	2.2	94	
3	22:30	0.4	1.45	851.81	144	251	249	63	84	75	6.5	2.2	91	
4	25:00	0.38	1.38	853.38	144	250	251	59	86	75	7.5	2	97	
5	27:30	0.3	1.09	854.82	144	247	250	57	86	76	7.5	1.9	97	
6	30:00	0.25	0.91	856.137	144	246	246	55	87	76	7	1.9	95	
	Total	*7.1267	15.46		1729				977	892				
	Average	0.5939												

* Sum of square roots.

Circle correct bracketed units on data sheet.

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TEST LOCATION: Stack H_2SO_4 **TESTING** **METHOD:** 8 **PAGE** 2 **OF** 2

UNIT: FCC Regenerator Vent **RUN:** 3

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville	Date	3-20-14
Meter Operator	M LePesche		
Probe Operator	A Christiansen		

Meter Box	66-24	Sample Box No.	FB-2
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7420
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.000 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.000 [cfm] [Lpm]	@	17 (in. Hg)
Pitot Leak Check Before: ☑		After: Good ☒ Bad ☐	

Cross-Section of Test Location

Duct Dimensions (in.)	156		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	72	Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	–	N/A	–
Thimble No.	–	N/A	–
Nozzle Diameter	275	Nozzle I.D.	275-1

Start Time:	13:26	Stop Time:	14:32

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L] 837.518	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☒ 1MPS	Notes
4-1	32:30	0.38	1.38	857.80	144	250	259	55	86	77	14.5	2.2	84	
2	35:00	0.4	1.45	859.53	145	251	256	53	88	78	12.5	2	76	
3	37:30	0.4	1.45	861.29	144	251	253	52	89	78	9.5	2.1	82	
4	40:00	0.36	1.31	863.06	145	246	252	52	89	80	5.5	2.2	91	
5	42:30	0.29	1.05	864.62	144	247	251	51	86	78	4	1.9	95	
6	45:00	0.25	0.91	865.823	144	248	249	51	84	78	5	2.1	94	
3-1	47:30	0.38	1.38	867.43	144	253	253	54	82	77	12	2.3	78	
2	50:00	0.42	1.52	869.18	144	251	251	53	83	77	10	2.5	76	
3	52:30	0.4	1.45	870.87	144	251	251	53	84	77	8.5	2.3	84	
4	55:00	0.4	1.45	872.54	144	250	249	53	84	77	8.5	2	90	
5	57:30	0.32	1.16	874.12	145	250	249	54	85	77	7.5	2.1	93	
6	60:00	0.32	1.16	875.~~780~~ 698	144	249	251	54	85	77	7.5	2.3	92	
	Total	7.1807	15.67	38.1800 M 3/20 DM 3/28	1731				1025	931				
	Average	0.5962	1.2971		144.1667				179.6875					

Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC M

Date 3/26

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TEST LOCATION: Stack H_2SO_4 TESTING METHOD: 8 PAGE 2 OF 2

UNIT: FCC Regenerator Unit RUN: 2

FIELD DATA SHEET

Client	Marathon	Project No.	12401
Plant	Garyville, LA	Date	3-21-14
Meter Operator	M LeBleu		
Probe Operator	A Christiansen		

Meter Box	66-74	Sample Box No.	M5
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7470
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.001 (cfm) [Lpm]	@	7 (in. Hg)
Leak Rate After	[cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒ Bad ☐		

Cross-Section of Test Location

Duct Dimensions (in.)	156		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	69	Bar. Press.	29.91 [in. Hg] [mbar]
Probe I.D. No.	67-C1		
Liner Material	Glass		

Filter No.	—	N/A	—
Thimble No.	—	N/A	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	4:23	Stop Time:	7:32

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft³) [L] 875.943	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☒ 1 mpS	Notes
1-1	27:30	0.42	1.52	897.05	144	249	248	65	82	78	9	1.8	94	
2	35:00	0.42	1.52	898.86	144	249	250	63	88	79	7.5	1.6	88	
3	37:30	0.42	1.52	900.68	144	249	250	63	91	79	7	1.4	99	
4	40:00	0.38	1.38	902.38	144	249	250	63	92	80	5	1.4	103	
5	42:30	0.32	1.16	904.00	144	250	250	62	93	81	0.5	1.9	104	
6	45:00	0.32	1.16	905.500	144	249	249	63	93	81	7	1.9	102	
2-1	47:30	0.42	1.52	906.13	144	248	250	61	90	82	11	1.8	82	
2	50:00	0.42	1.52	908.51	144	249	253	58	92	83	13	1.9	80	
3	52:30	0.42	1.52	910.73	144	251	255	57	93	84	6.5	1.8	89	
4	55:00	0.37	1.35	912.41	144	250	250	56	94	84	5	2	96	
5	57:30	0.37	1.35	914.08	144	250	250	55	94	84	5	1.8	96	
6	60:00	0.36	1.31	915.726	144	250	251	55	95	85			96	
	Total	*7.4528	16.83		1728				1047	980				
	Average	0.6148	1.3767		144.2333				87.2292					

*Sum of square roots.

Circle correct bracketed units on data sheet.

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Date 3/24

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TEST LOCATION: Stack H_2SO_4 TESTING METHOD: 8 PAGE 1 OF 2

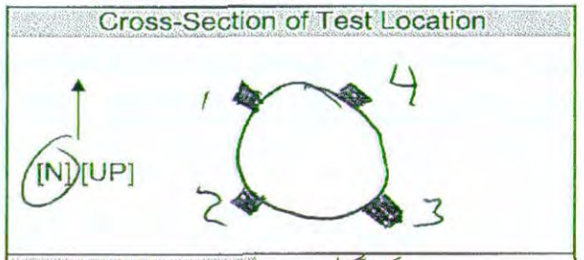
UNIT: FCC Regenerator Unit RUN: 4

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-21-14
Meter Operator	M LeRoche		
Probe Operator	A Christiansen		

Meter Box	66-24	Sample Box No.	M5
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.00 (cfm) [Lpm]	@	17 (in. Hg)
Leak Rate After	0.000 (cfm) [Lpm]	@	18 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	156		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] (Out) of page	First point all the way (In) Out
0.2	9.25		

Amb. Temp. (°F)	69	Bar. Press.	29.91 (in. Hg) [mbar]
Probe I.D. No.	C7-6-1		
Liner Material	Glass		

Filter No.	—	N/A	—
Thimble No.	—	N/A	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time: 8:23 Stop Time: 9:32

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☒ Imps	Notes
				875.943		250	250							
3-1	2:30	0.42	1.57	877.67	145	248	252	65	71	69	7.5	2.2	65	
2	5:00	0.42	1.52	879.41	145	249	254	53	74	70	7.5	1.7	82	
3	7:30	0.43	1.56	881.20	145	250	252	49	78	71	4.5	1.5	101	
4	10:00	0.4	1.45	882.90	145	250	250	48	82	71	3.5	1.2	108	
5	12:30	0.33	1.20	884.45	145	247	244	50	84	72	3	1.6	107	
6	15:00	0.27	0.98	885.881	145	248	253	52	84	73	3	1.7	100	
4-1	17:30	0.4	1.45	887.53	145	248	251	56	84	74	9	1.5	88	
2	20:00	0.42	1.52	889.26	145	249	252	57	84	74	8.5	1.5	89	
3	22:30	0.42	1.52	890.98	144	250	250	59	87	75	9	1.7	100	
4	25:00	0.37	1.35	892.66	144	250	249	61	88	75	9	1.3	107	
5	27:30	0.32	1.16	894.23	144	250	252	63	89	76	7	1.3	110	
6	30:00	0.27	0.98	895.682	144	250	252	64	88	77	5	1.7	111	
	Total	7.3006	16.21	19.78300 DM 3128	1736				993	877				
	Average	.6084												

* Sum of square roots.

Circle correct bracketed units on data sheet.

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TEST LOCATION: Stack H_2SO_4 TESTING METHOD: 8 PAGE 1 OF 2

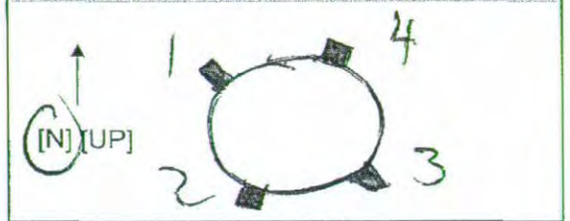
UNIT: FCC Regenerator Vent RUN: 5

FIELD DATA SHEET

Client	Marathon	Project No.	12481
Plant	Garyville, LA	Date	3-21-14
Meter Operator	M LeBlanc		
Probe Operator	A Christiansen		

Meter Box	66-24	Sample Box No.	M7
Meter Y_d	0.993	Meter $\Delta H_@$	1.7476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.00 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.003 [cfm] [Lpm]	@	17 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	156.		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] (Out) of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	79	Bar. Press.	29.91 (in. Hg) [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	—	N/A	—
Thimble No.	—	N/A	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time: 10:06 Stop Time: 11:11

Traverse Point Number	Min/pt / Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft³) [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☒ Imp 5	Notes
	2.5			~~913.130~~ 915.100		250	250							
2-1	2:30	0.4	1.45	917.87	144	251	251	63	79	82	6.5	2.1	61	
2	5:00	0.41	1.49	919.59	144	253	254	59	81	81	7	1.4	68	
3	7:30	0.4	1.45	921.30	144	252	254	57	82	81	7	1.5	78	
4	10:00	0.4	1.45	923.04	144	254	258	55	84	80	6.5	1.5	83	
5	12:30	0.37	1.35	924.77	144	253	256	55	86	81	3.5	1.8	67	
6	15:00	0.30	1.09	926.286	144	252	253	56	87	80	7.5	1.8	89	
1-1	17:30	0.4	1.45	927.99	144	249	250	62	85	79	4.5	1.8	82	
2	20:00	0.42	1.52	929.70	144	246	249	58	88	80	5	1.7	81	
3	22:30	0.42	1.52	931.44	144	248	250	57	87	79	5	1.6	83	
4	25:00	0.43	1.56	933.20	143	249	251	57	87	79	5	2	84	
5	27:30	0.38	1.38	934.88	144	250	249	58	88	79	4.5	2.1	95	
6	30:00	0.38	1.38	936.502	144	249	249	59	90	79	4.5	1.7	85	
	Total	7.5109	17.09		1727				1028	960				
	Average	0.6259												

Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC 4
Date 4/17/14

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TEST LOCATION: Stack H_2SO_4 **TESTING METHOD:** 8 **PAGE** 2 **OF** 2

UNIT: FCC Regenerator Vent **RUN:** 5

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3/21-14
Meter Operator	M LeRoche		
Probe Operator			

Cross-Section of Test Location

Amb. Temp. (°F)	71	Bar. Press.	29.91 (in. Hg) [mbar]
Probe I.D. No.	C7-6-1		
Liner Material	Glass		

Meter Box	66-24	Sample Box No.	M7
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.001 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.008 [cfm] [Lpm]	@	15 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒ Bad ☐		

Filter No.	—	N/A	—
Thimble No.	—	N/A	—
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Duct Dimensions (in.) 156

Static Pres ($in. H_2O$)	Port Len. (in.)	Gas Flow [In] (Out) of page	First point all the way [In] [Out]
0.2	9.25		

Start Time: 10:06 Stop Time: 11:11

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP ($in. H_2O$)	Orifice Setting ΔH ($in. H_2O$)	Gas Sample Volume V_m Init. Vol. (ft³) [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☒ Imps	Notes
4 - 1	32:30	0.38	1.38	938.12	144	250	251	63	88	80	7	2.1	80	
2	35:00	0.43	1.56	939.85	144	250	255	61	91	81	8	1.8	78	
3	37:30	0.42	1.52	921.56	144	250	254	61	93	82	8.5	1.9	80	
4	40:06	0.25	0.91	943.14	144	249	250	63	94	82	4.5	1.7	84	
5	42:30	0.25	0.91	944.54	144	250	252	65	94	83	4.5	1.8	86	
6	45:00	0.25	0.91	945.911	144	250	250	68	95	84	3.5	2.1	86	
3 - 1	47:30	0.36	1.38	947.60	144	247	254	70	94	84	10.5	2.2	82	
2	50:06	0.41	1.49	949.35	145	248	252	66	96	85	10	2.1	80	
3	52:30	0.4	1.45	951.10	148	249	251	63	96	85	9.5	2.2	83	
4	55:00	0.33	1.20	952.70	145	249	250	64	95	86	7	2.2	85	
5	57:30	0.32	1.16	954.28	145	250	253	65	96	86	6	2.3	66	
6	60:00	0.3	1.09	955.86	145	249	252	66	95	86	5	2.2	86	
	Total	6.0473	14.96	42.730	1733				1177	1004				
	Average	0.6045	1.3354		144.08				85.975					

Sum of square roots. Circle correct bracketed units on data sheet

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QA/QC Date

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TEST LOCATION: Stack H_2SO_4 TESTING METHOD: 8 PAGE 1 OF 2

UNIT: FCC Regenerator Vent RUN: 6

FIELD DATA SHEET

Client	Marathon	Project No.	12414
Plant	Garyville, LA	Date	3-21-14
Meter Operator	M Lefresche		
Probe Operator	A Christiansen		

Meter Box	66-24	Sample Box No.	
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7476
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.001 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.002 [cfm] [Lpm]	@	15 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒ Bad ☐		

Cross-Section of Test Location

Duct Dimensions (in.)	56		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	87	Bar. Press.	29.91 [in. Hg] [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	—	N/A	—
Thimble No.	—	N/A	—
Nozzle Diameter	0.775	Nozzle I.D.	775-1

Start Time:	11:42	Stop Time:	12:48

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☒ Imp 5	Notes
				956.460		250	250							
3-1	02:30	0.4	1.45	959.52	145	250	249	67	85	85	8	2.4	71	
2	05:00	0.4	1.45	960.25	145	252	256	52	87	85	7.5	2.1	76	
3	07:30	0.4	1.45	962.01	145	252	257	47	88	84	6.5	2.1	96	
4	10:00	0.4	1.45	963.78	145	251	250	45	88	84	5	2.1	99	
5	12.30	0.33	1.20	965.44	144	251	253	44	89	83	3.5	1.9	103	
6	19:00	0.33	1.20	967.031	145	251	250	47	90	84	3.5	2	100	
4-1	17:30	0.4	1.45	968.64	144	250	247	50	86	82	5	2.9	86	
2	20.00	0.4	1.45	970.31	145	251	249	48	87	83	6	1.9	84	
3	22:30	0.4	1.45	972.02	144	250	250	48	88	87	5.5	2.1	91	
4	25:00	0.37	1.35	973.65	144	249	248	49	88	82	5.5	2.1	94	
5	27:30	0.3	1.09	975.14	144	248	249	49	87	82	5.5	2	94	
6	30:00	0.3	1.09	976.580	144	250	252	49	88	82	5.5	2.5	93	
	Total	*7.278	16.08		1734				1051	998				
	Average	0.6067												

* Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC SL
Date 4/27/14

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TEST LOCATION: Stack H_2SO_4 **TESTING** **METHOD:** 8 **PAGE** 2 **OF** 2

UNIT: FCC Regenerator Vent **RUN:** 6

FIELD DATA SHEET

Client	Marathon	Project No.	12461
Plant	Garyville, LA	Date	3-21-14
Meter Operator	M LeResche		
Probe Operator	A Christiansen		

Meter Box	66-24	Sample Box No.	
Meter Y_d	0.9931	Meter $\Delta H_@$	1.7976
K Factor	3.63	Pitot C_p	0.831
Leak Rate Before	0.001 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.002 [cfm] [Lpm]	@	13 (in. Hg)
Pitot Leak Check Before: ☒	After: Good ☒ Bad ☐		

Cross-Section of Test Location

Duct Dimensions (in.)	156		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	87	Bar. Press.	29.91 [in. Hg] [mbar]
Probe I.D. No.	67-6-1		
Liner Material	Glass		

Filter No.	–	N/A	–
Thimble No.	–	N/A	–
Nozzle Diameter	0.275	Nozzle I.D.	275-1

Start Time:	11:42	Stop Time:	12:48

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L] 956.760	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ Imp 5	Notes
1-1	32:30	0.4	1.45	978.20	145	249	242	54	85	82	13.5	2.5	84	
2	35:00	0.42	1.52	979.98	144	247	247	51	87	81	13	2.3	73	
3	37:30	0.43	1.56	981.78	144	247	243	50	87	81	12.5	2.3	77	
4	40:00	0.27	0.98	983.30	143	248	250	51	86	81	6.5	2.4	82	
5	42:30	0.27	0.98	984.73	144	252	257	53	87	81	6.5	2.3	88	
6	45:00	0.27	0.98	986.105	144	253	257	53	87	81	6.5	2.2	89	
2-1	47:30	0.4	1.45	987.75	144	246	242	55	86	81	12	2.5	77	
2	50:00	0.4	1.45	989.46	144	246	244	54	87	81	8	2.2	76	
3	52:30	0.4	1.45	991.15	144	248	250	52	88	81	6.5	2	81	
4	55:00	0.37	1.35	992.70	144	249	251	53	88	81	7	2.2	86	
5	57:30	0.37	1.35	994.27	144	250	251	53	89	81	10	2.2	86	
6	60:00	0.30	1.09	995.900	144	250	250	54	89	81	9	2	82	
	Total	7.1568	14.242	39.1400	1728				1046	973				
	Average	0.6016	1.2634		144.2500				84.7500					

Sum of square roots. 15.61 DM 3/28

1.3204 DM 3/28

Circle correct bracketed units on data sheet.

QA/QC M
Date 3/21

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TEST LOCATION: Stack HCN TESTING METHOD: OTM 29 PAGE 1 OF 2

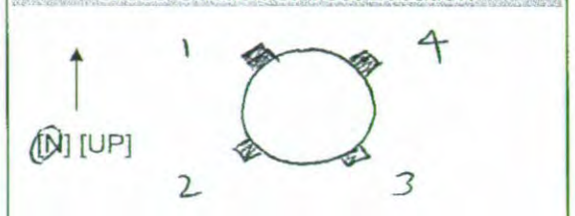
UNIT: FCC ~~Regenerator~~ Vent RUN: 1

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3-18-14
Meter Operator	I. LOPEZ		
Probe Operator	A. Christiansen		

Meter Box	66-21	Sample Box No.	M-3
Meter Y_d	0.9884	Meter $\Delta H_@$	1.7537
K Factor	2.48	Pitot C_p	0.832
Leak Rate Before	0.003 (cfm) [Lpm]	@	15 (in. Hg)
Leak Rate After	0.002 (cfm) [Lpm]	@	10 (in. Hg)
Pitot Leak Check Before: ☑	After: Good ☑	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] (Out) of page	First point all the way [In] [Out]
0.2	9.25		[In] [Out]

Amb. Temp. (°F)	63	Bar. Press.	29.76 (in. Hg) [mbar]
Probe I.D. No.	67MS-6-10		
Liner Material	Glass		

Filter No.	OTM	29	R-1
Thimble No.	—	N/A	—
Nozzle Diameter	0.250	Nozzle I.D.	250.1

Start Time:	1045	Stop Time:	1201

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft³) [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☐ N/A	Notes
				143.080		250	250							
3-1	2.5	0.39	0.97	144.41	143	251	247	57	61	60	5.0	8.2	N/A	
3-2	5.0	0.41	1.0	145.83	143	254	246	54	61	60	5.0	5.9	N/A	
3-3	7.5	0.41	1.0	147.27	143	255	247	53	62	60	5.0	5.6	N/A	
3-4	10.0	0.41	1.0	148.37	143	258	250	53	64	60	5.0	3.7	N/A	
3-5	12.5	0.35	0.87	150.02	143	256	253	56	66	60	5.0	1.4	N/A	
3-6	15.0	0.35	0.87	151.485	143	252	256	57	67	61	5.0	1.4	N/A	
2-1	17.5	0.39	0.97	152.82	143	252	257	60	66	62	5.0	2.6	N/A	
2-2	20.0	0.38	0.91	154.18	143	257	256	61	69	63	5.0	2.1	N/A	
2-3	22.5	0.38	0.91	155.46	143	260	259	61	69	63	5.0	1.7	N/A	
2-4	25.0	0.37	0.92	156.92	143	256	261	62	70	63	5.0	1.3	N/A	
2-5	27.5	0.33	0.82	158.28	142	255	256	64	70	63	5.0	1.2	N/A	
2-6	30.0	0.30	0.74	159.435	142	255	258	59	70	63	5.0	1.4	N/A	
	Total	7.3165*	10.98	32.2700	1714				795	738				
	Average	0.6011*	0.8938*		143.0833				66.125					

* Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC BV
Date 3-18-14

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TEST LOCATION: Stack HCN TESTING METHOD: OTM 29 PAGE 2 OF 2

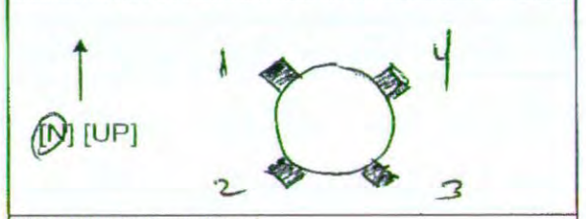
UNIT: FCC Regenerator Vent RUN: 1

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3-18-14
Meter Operator	I. Lopez		
Probe Operator	A. Christensen		

Meter Box	66-21	Sample Box No.	M-3
Meter Y_d		Meter $\Delta H_@$	
K Factor		Pitot C_p	
Leak Rate Before	[cfm] [Lpm]	@	(in. Hg)
Leak Rate After	[cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐		

Cross-Section of Test Location



Duct Dimensions (in.)			
Static Pres ($in. H_2O$)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	63	Bar. Press.	29.76 [in. Hg] [mbar]
Probe I.D. No.			
Liner Material			

Filter No.			
Thimble No.			
Nozzle Diameter		Nozzle I.D.	

Start Time:		Stop Time:	

Traverse Point Number	Min/pt / Elapsed Time	Velocity Head ΔP ($in. H_2O$)	Orifice Setting ΔH ($in. H_2O$)	Gas Sample Volume V_m Init. Vol. [ft^3] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
1 - 1	32.5	0.39	0.97	160.82	143	250	257	60	67	64	5.0	1.9	N/A	
1 - 2	35.0	0.38	0.94	162.10	143	253	256	53	71	64	5.0	2.2	N/A	
1 - 3	37.5	0.40	0.99	163.58	143	255	257	48	72	65	5.0	2.0	N/A	
1 - 4	40.0	0.45	1.1	165.07	143	248	253	46	71	65	5.5	2.1	N/A	
1 - 5	42.5	0.41	1.0	166.49	143	248	254	44	70	64	5.0	2.2	N/A	
1 - 6	45.0	0.32	0.79	167.78	143	243	255	44	72	65	5.0	2.6	N/A	
4 - 1	47.5	0.34	0.84	169.11	144	247	257	45	70	66	5.0	3.1	N/A	
4 - 2	50.0	0.26	0.64	170.30	144	257	259	45	71	66	4.0	3.2	N/A	
4 - 3	52.5	0.36	0.89	171.56	144	254	259	45	72	66	5.0	3.2	N/A	
4 - 4	55.0	0.37	0.92	173.03	144	247	256	45	72	66	5.0	2.9	N/A	
4 - 5	57.5	0.29	0.72	174.15	143	255	259	45	74	67	4.5	2.7	N/A	
4 - 6	60.0	0.27	0.67	175.350	143	256	258	45	74	67	4.5	2.9	N/A	
	Total	*7.1096	10.47	32.210	1720				856	785				
	Average													

* Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC MV
Date 3-18-14

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TEST LOCATION: Stack HCN TESTING METHOD: OTM 29 PAGE 1 OF 2

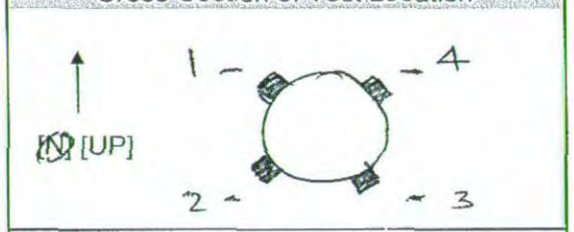
UNIT: FCC Regenerator Vent RUN: 2

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3-18-14
Meter Operator		I. LOPEZ	
Probe Operator		A. Christiansen	

Meter Box	66-21	Sample Box No.	M-2
Meter Y_d	0.9884	Meter $\Delta H_@$	1.7537
K Factor	248 @ 3-18-14	Pitot C_p	0.832
Leak Rate Before	0.003 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.001 [cfm] [Lpm]	@	12 (in. Hg)
Pitot Leak Check Before: ☑	After: Good ☑	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	68	Bar. Press.	29.76 [in. Hg] [mbar]
Probe I.D. No.	67MS-6-10		
Liner Material	Glass		

Filter No.	OTM	29	R-2
Thimble No.	—	N/A	—
Nozzle Diameter	~~0.250~~ 0.235 ← (20) → 3-18-14	Nozzle I.D.	~~250~~-1 235-1

Start Time:	1756	Stop Time:	1909

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
				176.510		250	250							K-Factor
4-1	2.5	0.39	076	177.80	142	252	253	60	74	77	4.0	12.2	N/A	Change 1.94
4-2	5.0	0.40	0.78	179.09	142	258	252	55	74	77	4.5	1.9	N/A	
4-3	7.5	0.42	0.81	180.41	142	256	256	52	74	76	4.5	1.6	N/A	
4-4	10.0	0.42	081	181.74	147	247	243	52	75	77	4.5	1.6	N/A	
4-5	12.5	0.36	0.70	183.00	142	248	249	49	75	76	4.0	1.5	N/A	
4-6	15.0	0.32	0.62	184.210	142	253	254	49	75	76	4.0	1.4	N/A	
1-1	17.5	0.41	0.80	185.49	143	242	246	54	75	75	4.5	1.8	N/A	
1-2	20.0	0.43	0.83	186.81	143	248	246	54	76	75	4.5	1.5	N/A	
1-3	22.5	0.40	0.78	188.09	143	246	248	55	77	76	4.0	1.6	N/A	
1-4	25.0	0.40	0.78	189.37	143	246	250	54	78	75	4.0	1.5	N/A	
1-5	27.5	0.33	0.64	190.68	143	250	259	55	79	75	4.0	1.4	N/A	
1-6	30.0	0.33	0.64	191.780	143	245	247	56	80	76	4.0	1.5	N/A	
	~~32.5~~													
	Total	7.4287	8.4500	29.5900	1715				912	911				
	Average	0.6096	0.7238		143.0833				76.2500					

Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC IL
Date 3-18-14

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TEST LOCATION: Stack HCN TESTING METHOD: OTM 29 PAGE 2 OF 2

UNIT: FCC Reinegrator Vent RUN: 2

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	GARYVILLE, LA	Date	3-18-14
Meter Operator	I. LOPEZ		
Probe Operator	A. Christianson		

Meter Box		Sample Box No.		
Meter Y_d		Meter $\Delta H_@$		
K Factor		Pitot C_p		
Leak Rate Before	[cfm] [Lpm]	@		(in. Hg)
Leak Rate After	[cfm] [Lpm]	@		(in. Hg)
Pitot Leak Check Before: ☐	After: Good ☐	Bad ☐		

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)			
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	68	Bar. Press.	29.76 [in. Hg] [mbar]
Probe I.D. No.	67MS-6-10		
Liner Material	Glass		

Filter No.			
Thimble No.			
Nozzle Diameter		Nozzle I.D.	

Start Time:		Stop Time:	

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
2-1	32.5	0.41	0.80	193.08	143	248	247	60	76	76	4.0	1.6	N/A	
2-2	35.0	0.41	0.80	194.37	143	249	248	58	78	76	4.0	1.5	N/A	
2-3	37.5	0.40	0.78	195.66	144	246	256	58	80	77	4.0	1.4	N/A	
2-4	40.0	0.38	0.74	196.93	143	247	257	56	79	76	4.0	1.2	N/A	
2-5	42.5	0.37	0.72	198.26	143	245	262	57	80	76	4.0	1.2	N/A	
2-6	45.0	0.35	0.68	199.300	143	247	258	57	79	76	4.0	1.5	N/A	
3-1	47.5	0.33	0.64	200.47	143	246	258	58	74	75	4.0	1.4	N/A	
3-2	50.0	0.30	0.58	201.58	143	244	260	58	76	75	3.5	1.5	N/A	
3-3	52.5	0.34	0.66	202.69	143	253	257	57	77	75	4.0	1.7	N/A	
3-4	55.0	0.37	0.72	203.90	143	256	258	57	77	75	3.5	1.8	N/A	
3-5	57.5	0.34	0.66	205.00	143	257	259	57	77	75	3.5	1.8	N/A	
3-6	60.0	0.33	0.64	206.100	145	251	251	57	77	75	3.5	1.8	N/A	
	Total	7.2005	8.4200		1719				930	907				
	Average													

* Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC JK Date 3-18-14

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TEST LOCATION: Stack HCN **TESTING METHOD:** OTM 29 **PAGE** 1 **OF** 2

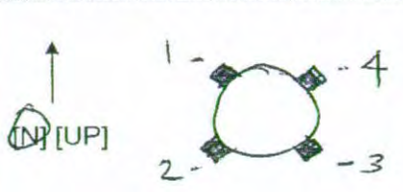
UNIT: FCC Regenerator Vent **RUN:** 3

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	I. Lopez		
Probe Operator	A. Christianson		

Meter Box	66.21	Sample Box No.	M-2
Meter Y_d	0.9884	Meter $\Delta H_@$	1.7537
K Factor	1.7	Pitot C_p	0.832
Leak Rate Before	0.003 [cfm] [Lpm]	@	15 (in. Hg)
Leak Rate After	0.004 [cfm] [Lpm]	@	12 (in. Hg)
Pitot Leak Check Before: ☑	After: Good ☑	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
+0.2	9.25		

Amb. Temp. (°F)	67	Bar. Press.	29.96 (in. Hg) [mbar]
Probe I.D. No.	67M5-6-10		
Liner Material	Glass		

Filter No.	R-3	OTM	29
Thimble No.	—	N/A	
Nozzle Diameter	0.235	Nozzle I.D.	235-1

Start Time:	914	Stop Time:	1023

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. 209.285 (ft³) [L]	Stack Temp. Ts (°F)	Probe T_p Set Points 250	Filter T_f Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
3-1	2.5	0.38	0.65	210.46	143	257	254	62	64	64	4.0	19.2	N/A	
3-2	5.0	0.39	0.66	211.59	143	258	253	49	65	64	4.0	1.7	N/A	
3-3	7.5	0.40	0.68	212.72	144	255	250	48	65	64	4.0	1.6	N/A	
3-4	10.0	0.40	0.68	213.91	143	258	254	47	65	64	4.0	1.3	N/A	
3-5	12.5	0.35	0.60	214.96	144	258	252	47	66	64	4.0	1.4	N/A	
3-6	15.0	0.30	0.51	215.965	143	250	252	47	65	64	4.0	1.5	N/A	
2-1	17.5	0.39	0.66	217.08	144	256	254	51	63	62	4.0	2.2	N/A	
2-2	20.0	0.31	0.53	218.12	144	259	249	47	63	62	3.5	2.4	N/A	
2-3	22.5	0.41	0.70	219.30	144	263	251	47	63	62	4.0	2.2	N/A	
2-4	25.0	0.40	0.68	220.44	143	261	247	47	63	62	4.0	2.5	N/A	
2-5	27.5	0.38	0.65	221.61	146	259	251	47	64	62	4.0	2.3	N/A	
2-6	30.0	0.32	0.54	222.650	143	260	254	47	64	62	4.0	2.1	N/A	
	Total	~~7.2814~~ 7.54		26.4950	1724				770	756				
	Average	0.5990	0.6121		143.750				66.7708					

Sum of square roots. Circle correct bracketed units on data sheet.

QA/QC BL
Date 3-19-14

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TEST LOCATION: Stack HCN **TESTING METHOD:** OTM 29 **PAGE** 2 **OF** 2

UNIT: FCC Regenerator Vent **RUN:** 3

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	I. Lopez		
Probe Operator	A. Christiansen		

Meter Box	66-21	Sample Box No.	M-2
Meter Y_d		Meter $\Delta H_@$	
K Factor		Pitot C_p	
Leak Rate Before	[cfm] [Lpm]	@	(in. Hg)
Leak Rate After	[cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐		

Cross-Section of Test Location

Duct Dimensions (in.)			
Static Pres ($in. H_2O$)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	67	Bar. Press.	29.96 (in. Hg) [mbar]
Probe I.D. No.	67MS-6.10		
Liner Material	Glass		

Filter No.		
Thimble No.		
Nozzle Diameter	Nozzle I.D.	

Start Time:	Stop Time:

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP ($in. H_2O$)	Orifice Setting ΔH ($in. H_2O$)	Gas Sample Volume V_m Init. Vol. (ft³) [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
1 - 1	32.5	0.32	0.54	223.70	144	256	252	56	66	62	4.0	2.4	N/A	Pump Vacuum
1 - 2	35.0	0.36	0.61	224.77	144	253	251	55	68	62	3.5	2.6	N/A	4.0 (JW) 3-19-14
1 - 3	37.5	0.40	0.68	225.92	144	258	258	54	70	64	4.0	2.8	N/A	
1 - 4	40.0	037	0.63	227.08	144	258	253	54	72	64	4.0	2.6	N/A	
1 - 5	42.5	0.31	0.53	228.11	143	262	255	55	73	65	3.5	2.5	N/A	
1 - 6	45.0	0.27	0.46	229.075	143	258	255	56	74	66	3.0	2.6	N/A	
4 - 1	47.5	0.39	0.66	230.25	144	260	253	58	75	67	4.0	4.5	N/A	
4 - 2	50.0	0.40	0.68	231.43	147	260	255	59	77	69	4.0	4.6	N/A	
4 - 3	52.5	040	0.68	232.63	143	258	250	59	76	69	4.0	5.0	N/A	
4 - 4	55.0	0.37	0.63	233.77	143	257	256	60	77	69	3.5	5.1	N/A	
4 - 5	57.5	0.32	0.54	234.78	144	257	256	61	78	70	3.0	5.3	N/A	
4 - 6	60.0	0.30	0.51	235.780	143	252	251	61	76	70	3.0	5.5	N/A	
	Total	7.0939	7.1500		1726				882	797				
	Average													

* Sum of square roots.

Circle correct bracketed units on data sheet.

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Date 3-19-14

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TEST LOCATION: Stack | HCN | TESTING METHOD: OTM 29 PAGE 1 OF 2

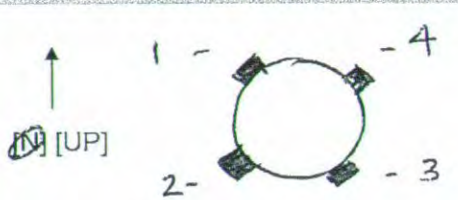
UNIT: FCC Regenerator Vent RUN: 4

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	I. Lopez		
Probe Operator	A Christiansen		

Meter Box	66-21	Sample Box No.	M-3
Meter Y_d	0.9884	Meter $\Delta H_@$	1.7537
K Factor	1.7	Pitot C_p	0.832
Leak Rate Before	0.002 [cfm] [Lpm]	@	16 (in. Hg)
Leak Rate After	0. [cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☑	After: Good ☑	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		[In] [Out]

Amb. Temp. (°F)	69	Bar. Press.	29.96 (in. Hg) [mbar]
Probe I.D. No.	CTMS-6-10		
Liner Material	Glass		

Filter No.	R-4	OTM	29
Thimble No.	—	N/A	—
Nozzle Diameter	0.235	Nozzle I.D.	0235-1

Start Time:	11:23	Stop Time:	1232

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft³) [L] 236.030	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%.dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
4-1	2.5	0.39	0.66	237.25	144	257	255	62	70	70	4.0	8.5	N/A	
4-2	5.0	0.36	0.61	238.35	146	258	254	61	71	70	3.5	8.5	N/A	
4-3	7.5	0.36	0.61	239.50	144	254	252	57	72	70	3.5	9.0	N/A	
4-4	10.0	0.36	0.61	240.59	144	253	251	57	72	70	3.5	9.2	N/A	
4-5	12.5	0.27	0.46	241.55	147	252	252	58	74	71	3.0	9.5	N/A	
4-6	15.0	0.27	0.46	242.525	144	255	251	59	75	71	3.0	11.9	N/A	
1-1	17.5	0.38	0.65	243.72	143	249	252	62	74	71	4.0	9.0	N/A	
1-2	20.0	0.39	0.66	244.90	143	247	246	58	76	71	4.0	9.2	N/A	
1-3	28.5	0.41	0.70	246.11	143	246	246	56	77	72	4.0	10.1	N/A	
1-4	25.0	0.41	0.70	247.31	143	251	247	54	77	72	4.0	10.0	N/A	
1-5	27.5	0.35	0.60	248.46	143	246	249	53	76	72	3.5	10.3	N/A	
1-6	30.0	0.30	0.51	249.470	143	247	252	53	76	72	3.5	11.0	N/A	
	Total	*7.1246	7.230	26.1700	1727				890	852				
	Average	0.5884	0.5924		143.6667				74.3542					

* Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC JW
Date 3-19-14

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TEST LOCATION: Stack HCN **TESTING** **METHOD:** OTM 29 **PAGE** 2 **OF** 2

UNIT: FCC Regenerator Vent **RUN:** 4

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	I. LOPEZ		
Probe Operator	A. Christansen		

Meter Box	66-21	Sample Box No.	M-3
Meter Y_d		Meter $\Delta H_@$	
K Factor		Pitot C_p	
Leak Rate Before	[cfm] [Lpm]	@	(in. Hg)
Leak Rate After	[cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐		

Cross-Section of Test Location

↑ [N] [UP]

Duct Dimensions (in.)

Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	69	Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	67MS-6-10		
Liner Material	Glass		

Filter No.			
Thimble No.			
Nozzle Diameter		Nozzle I.D.	

Start Time: Stop Time:

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
2-1	32.5	0.40	0.68	250.67	143	259	255	56	74	72	4.0	10.3	N/A	
2-2	35.0	0.28	0.48	251.63	143	261	257	56	77	72	3.0	10.4	N/A	
2-3	37.5	0.38	0.65	252.82	144	263	255	56	77	72	3.5	11.3	N/A	
2-4	40.0	0.38	0.65	254.01	144	262	254	57	78	73	3.5	10.1	N/A	
2-5	42.5	0.36	0.61	255.08	143	260	255	57	79	73	3.5	10.2	N/A	
2-6	45.0	0.32	0.54	256.170	144	258	254	59	81	74	3.0	10.2	N/A	
3-1	47.5	0.38	0.65	257.35	144	249	243	62	77	74	3.5	10.3	N/A	
3-2	50.0	0.30	0.51	258.40	143	252	252	60	78	74	3.0	9.8	N/A	
3-3	52.5	0.29	0.49	259.48	144	256	251	58	80	74	3.0	10.6	N/A	
3-4	55.0	0.37	0.63	260.60	143	258	254	57	80	75	3.5	10.8	N/A	
3-5	57.5	0.35	0.60	261.83	143	259	254	57	81	75	3.5	9.6	N/A	
3-6	60.0	0.29	0.49	262.790	143	258	251	56	81	76	3.0	9.3	N/A	
	Total	7.043	6.9800		1721				943	884				
	Average													

* Sum of square roots.

Circle correct bracketed units on data sheet.

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TEST LOCATION: Stack HCN TESTING METHOD: OTM 29 PAGE 1 OF 2

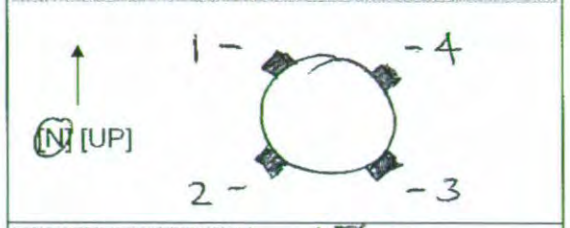
UNIT: FCC Regenerator Vent RUN: 5

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	I. Lopez		
Probe Operator	A. Christiansen		

Meter Box	66-21	Sample Box No.	M-2
Meter Y_d	0.9884	Meter $\Delta H_@$	1.7537
K Factor	17	Pitot C_p	0.832
Leak Rate Before	0.001 [cfm] [Lpm]	@	16 (in. Hg)
Leak Rate After	0.003 [cfm] [Lpm]	@	10 (in. Hg)
Pitot Leak Check Before: ☑	After: Good ☑	Bad ☐	

Cross-Section of Test Location



Duct Dimensions (in.)	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] (Out) of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	74	Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	67MS-6-10		
Liner Material	Glass		

Filter No.	OTM	29	R-5
Thimble No.	—	N/A	—
Nozzle Diameter	0.235	Nozzle I.D.	235.1

Start Time:	1327	Stop Time:	1438

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. 263.500 [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
3-1	2.5	0.40	0.68	264.69	144	256	247	65	80	77	4.0	8.0	N/A	
3-2	5.0	0.42	0.71	265.89	143	261	254	56	81	77	4.0	1.7	N/A	
3-3	7.5	0.40	0.68	267.09	143	263	256	53	83	78	4.0	1.5	N/A	
3-4	10.0	0.40	0.68	268.24	143	255	252	51	85	79	4.0	1.6	N/A	
3-5	12.5	0.36	0.61	269.29	143	254	252	51	85	79	4.0	1.6	N/A	
3-6	15.0	0.31	0.53	270.285	143	256	254	50	85	79	4.0	1.6	N/A	
2-1	17.5	0.39	0.66	271.41	143	256	254	57	83	80	4.0	1.8	N/A	
2-2	20.0	0.39	0.66	272.58	143	250	251	55	85	80	4.0	1.6	N/A	
2-3	22.5	0.40	0.68	273.84	143	254	252	56	85	81	4.0	1.5	N/A	
2-4	25.0	0.38	0.65	274.91	143	257	253	56	86	81	4.0	1.9	N/A	
2-5	27.5	0.31	0.53	276.00	143	254	252	58	85	82	4.0	1.7	N/A	
2-6	30.0	0.31	0.53	277.000	143	256	250	59	85	81	4.0	1.8	N/A	
	Total	7.3137	7.6000	27.1600	1717				1008	954				
	Average	0.6095	0.6375		1429583				83.6458					

Sum of square roots.

Circle correct bracketed units on data sheet

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QA/QC JL
Date 3-19-14

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TEST LOCATION: Stack — HCN — TESTING METHOD: OTM 29 PAGE 2 OF 2

UNIT: FCC Regenerator Vent RUN: 5

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	
Meter Operator	J. Lopez		
Probe Operator	A Christinson		

Meter Box	66.21	Sample Box No.	M-2
Meter Y_d		Meter $\Delta H_@$	
K Factor		Pitot C_p	
Leak Rate Before	[cfm] [Lpm]	@	(in. Hg)
Leak Rate After	[cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐		

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)

Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	74	Bar. Press.	29.96 (in. Hg) [mbar]
Probe I.D. No.	67M5-6-10		
Liner Material	Glass		

Filter No.			
Thimble No.			
Nozzle Diameter		Nozzle I.D.	

Start Time:	Stop Time:

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
1- 1	32.5	0.39	0.66	278.12	143	258	254	63	85	81	4.0	2.1	N/A	
1- 2	35.0	0.40	0.68	279.28	142	247	250	56	86	82	4.0	2.3	N/A	
1- 3	37.5	0.40	0.68	280.45	143	260	253	51	87	82	4.0	2.3	N/A	
1- 4	40.0	0.40	0.68	281.62	143	261	255	46	90	83	4.0	2.2	N/A	
1- 5	42.5	0.35	0.60	282.75	142	258	256	46	92	84	4.0	2.3	N/A	
1- 6	45.0	0.35	0.60	283.870	143	252	252	47	91	84	4.0	2.1	N/A	
4- 1	47.5	0.39	0.66	285.03	143	243	249	59	88	85	4.0	2.7	N/A	
4- 2	50.0	0.40	0.68	286.19	143	254	249	58	88	85	4.0	2.6	N/A	
4- 3	52.5	0.40	0.68	287.35	143	245	243	57	87	85	4.0	2.8	N/A	
4- 4	55.0	0.41	0.70	288.61	143	248	250	56	86	85	4.0	2.5	N/A	
4- 5	57.5	0.35	0.60	289.69	143	251	249	56	85	84	4.0	2.5	N/A	
4- 6	60.0	0.28	0.48	290.660	143	252	250	55	85	83	3.0	2.6	N/A	
	Total	*7.3556	7.7000		1714				1050	1003				
	Average													

* Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC [illegible]
Date 2-19-14

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TEST LOCATION: Stack HCN TESTING METHOD: OTM 29 PAGE 1 OF 2

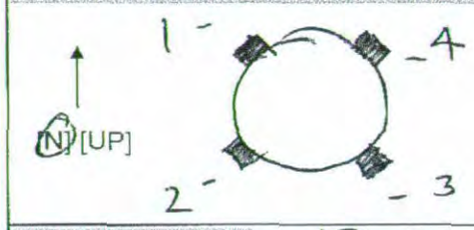
UNIT: FCC Regenerator Vent RUN: 6

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	I. Lopez		
Probe Operator	A. Christiansen		

Meter Box	6e-21	Sample Box No.	M-3		
Meter Y_d	0.9884	Meter $\Delta H_@$	1.7537		
K Factor	1.7	Pitot C_p	0.832		
Leak Rate Before	0.001 [cfm] [Lpm]	@	15	(in. Hg)	
Leak Rate After	0.001 [cfm] [Lpm]	@	8	(in. Hg)	
Pitot Leak Check Before: ☑	After: Good ☑	Bad ☐			

Cross-Section of Test Location



Duct Dimensions (in.)	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] (Out) of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	76	Bar. Press.	29.96 (in. Hg) [mbar]
Probe I.D. No.	67MS610		
Liner Material	Glass		

Filter No.	OTM	29	R-6
Thimble No.	—	N/A	—
Nozzle Diameter	0.235	Nozzle I.D.	235-1

Start Time:	15:31	Stop Time:	1641

Traverse Point Number	Min/pt / Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. 291.220 [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p Set Points (°F)	Filter T_f Set Points (°F)	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ NA	Notes
	2.5					250	250							
4-1	2.5	0.38	0.65	292.40	143	258	257	60	86	85	4.0	4.6	N/A	
4-2	5.0	0.38	0.65	293.56	142	259	256	51	87	85	4.0	2.5	N/A	
4-3	7.5	0.39	0.66	294.74	145	256	257	49	90	86	4.0	2.1	N/A	
4-4	10.0	0.37	0.63	295.90	143	254	251	46	90	86	4.0	2.0	N/A	
4-5	12.5	0.31	0.53	297.065	143	253	249	45	89	86	4.0	2.1	N/A	
4-6	15.0	0.29	0.49	298.100	142	246	248	45	90	87	4.0	2.1	N/A	
1-1	17.5	0.38	0.65	299.23	143	247	247	53	89	86	4.6	2.1	N/A	
1-2	20.0	0.39	0.66	300.41	143	246	248	50	89	87	4.5	2.0	N/A	
1-3	22.5	0.38	0.65	301.67	143	249	247	49	89	87	5.0	1.7	N/A	
1-4	25.0	0.39	0.63	302.77	143	243	250	48	89	86	4.5	1.9	N/A	
1-5	27.5	0.28	0.48	303.74	142	248	251	48	89	86	4.0	2.1	N/A	
1-6	30.0	0.28	0.48	304.730	143	248	251	49	89	86	4.0	1.9	N/A	
	Total	7.0849	7.1600	27.2800	1715				1066	1033				
	Average	14.4604	0.6221		142.8750				86.0625					

Sum of square roots. .6035 D.M 3/31

Circle correct bracketed units on data sheet.

QA/QC ZN
Date 3-19-14

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TEST LOCATION: Stack — HCN **TESTING** **METHOD:** OTM 29 **PAGE** 2 **OF** 2

UNIT: FCC Regenerator Vent **RUN:** 6

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3-19-14
Meter Operator	I. Lopez		
Probe Operator	A. Christiansen		

Meter Box	66-21	Sample Box No.	M-3
Meter Y_d		Meter $\Delta H_@$	
K Factor		Pitot C_p	
Leak Rate Before	[cfm] [Lpm]	@	(in. Hg)
Leak Rate After	[cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐		

Cross-Section of Test Location

Duct Dimensions (in.)

Static Pres ($in. H_2O$)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	76	Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	GTM5-G-10		
Liner Material	Glass		

Filter No.		
Thimble No.		
Nozzle Diameter	Nozzle I.D.	

Start Time:	Stop Time:

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP ($in. H_2O$)	Orifice Setting ΔH ($in. H_2O$)	Gas Sample Volume V_m Init. Vol. [ft^3] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dy)	☐ Amb Filter ☐ Dioxin Trap ☒ N/A	Notes
2-1	32.5	0.38	0.65	305.88	143	255	250	58	87	86	4.5	2.2	N/A	
2-2	35.0	0.36	0.61	307.05	143	251	248	53	87	86	4.0	1.8	N/A	
2-3	37.5	0.40	0.68	308.17	143	248	246	51	86	85	4.0	1.8	N/A	
2-4	40.0	0.40	0.68	309.36	143	251	252	51	85	85	4.0	2.0	N/A	
2-5	42.5	0.37	0.63	310.46	143	255	253	50	84	84	4.0	2.0	N/A	
2-6	45.0	0.35	0.60	311.58	143	255	250	51	85	84	4.0	2.1	N/A	
3-1	47.5	0.38	0.65	312.71	143	254	254	58	84	83	4.0	2.1	N/A	
3-2	50.0	0.40	0.68	313.90	143	255	253	55	84	83	4.0	2.0	N/A	
3-3	52.5	0.40	0.68	315.08	143	254	252	53	85	83	4.0	2.1	N/A	
3-4	55.0	0.38	0.65	316.23	142	249	250	53	85	83	4.0	2.1	N/A	
3-5	57.5	0.38	0.65	317.37	143	246	249	53	86	83	4.0	2.2	N/A	
3-6	60.0	0.36	0.61	318.500	142	246	249	53	86	83		2.0	N/A	
	Total	7.3955	7.770		1714				1024	1008				
	Average													

* Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC TV
Date 3-19-14

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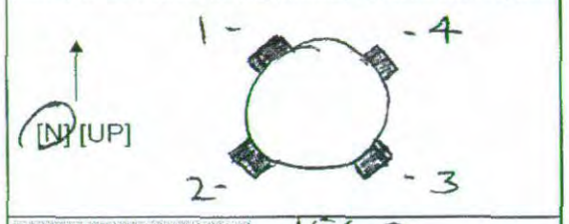
TEST LOCATION: Stack HCN TESTING METHOD: OTM 29 PAGE 1 OF 2

UNIT: FCC Regenerator RUN: 7

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3.20.14
Meter Operator	I. LOPEZ		
Probe Operator	A. Christiansen		

Cross-Section of Test Location



Amb. Temp. (°F)	68	Bar. Press.	29.96 (in. Hg) [mbar]
Probe I.D. No.	67M5-6.10		
Liner Material	G1455		

Meter Box	66-21	Sample Box No.	M-3
Meter Y_d	0.9884	Meter $\Delta H_@$	1.7537
K Factor	1.7	Pitot C_p	0.832
Leak Rate Before	0.001 (cfm) [Lpm]	@	16 (in. Hg)
Leak Rate After	0.001 (cfm) [Lpm]	@	4 (in. Hg)
Pitot Leak Check Before: ☑	After: Good ☑	Bad ☐	

Filter No.	OTM	29	R-7
Thimble No.	—	N/A	—
Nozzle Diameter	0.235	Nozzle I.D.	235.1

Duct Dimensions (in.)	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] (Out) of page	First point all the way [In] [Out]
+0.2	9.25		

Start Time:	9:31	Stop Time:	11:11

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft³) [L] 320.015	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
3-1	2.5	0.40	0.68	321.22	142	246	247	54	67	67	4.0	8.5	N/A	
3-2	5.0	0.41	0.70	322.43	142	248	249	49	68	67	4.0	8.2	N/A	
3-3	7.5	0.41	0.70	323.60	142	249	250	47	68	67	4.0	8.2	N/A	
3-4	10.0	0.38	0.65	324.74	142	243	247	44	69	67	4.0	4.9	N/A	
3-5	12.5	0.36	0.61	325.87	147	248	246	45	70	67	4.0	5.1	N/A	
3-6	15.0	0.32	0.54	326.92	142	252	252	44	70	67	4.0	4.8	N/A	
2-1	17.5	0.38	0.65	328.07	142	251	259	47	69	67	4.0	5.3	N/A	
2-2	20.0	0.39	0.66	329.25	143	255	257	45	71	67	4.0	5.0	N/A	
2-3	22.5	0.37	0.63	330.40	143	256	260	44	71	68	4.0	4.9	N/A	
2-4	25.0	0.37	0.63	331.69	142	257	259	44	72	67	4.0	4.9	N/A	
2-5	27.5	0.30	0.51	332.58	143	257	256	45	73	68	4.0	4.8	N/A	
2-6	30.0	0.29	0.49	333.535	143	259	259	46	74	68	4.0	4.9		
	Total	*7.2389	1.4502	27.1400	1713				842	807				
	Average	0.6044	0.6238		142.8750				70.2083					

* Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC JL
Date 3.20.14

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TEST LOCATION: Stack HCN TESTING METHOD: OTM 29 PAGE 2 OF 2

UNIT: FCC Regenerator Vent RUN: 7

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville LA	Date	3-20-14
Meter Operator	I. Lopez		
Probe Operator	A Cmustamsn		

Meter Box	66-21	Sample Box No.	M-3
Meter Y_d		Meter $\Delta H_@$	
K Factor		Pitot C_p	
Leak Rate Before	[cfm] [Lpm]	@	(in. Hg)
Leak Rate After	[cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☐	After: Good ☐ Bad ☐		

Cross-Section of Test Location

[N] [UP]

Duct Dimensions (in.)	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	68	Bar. Press.	29.96 [in. Hg] [mbar]
Probe I.D. No.	67M5-6-10		
Liner Material	Glass		

Filter No.			
Thimble No.	—	N/A	—
Nozzle Diameter		Nozzle I.D.	

Start Time:		Stop Time:	

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft³) [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
						250	250							
1 - 1	32.5	0.38	0.65	334.67	143	257	253	52	73	69	4.0	5.1	N/A	
1 - 2	35.0	0.40	0.68	335.88	143	251	251	49	73	70	4.5	4.3	N/A	
1 - 3	37.5	0.40	0.68	337.05	143	252	256	49	73	70	4.5	4.1	N/A	
1 - 4	40.0	0.38	0.65	338.22	143	255	258	48	74	70	3.9	4.0	N/A	3-20-14
1 - 5	42.5	0.35	0.60	339.32	143	255	256	49	75	70	3.9	4.0	N/A	3-20-14
1 - 6	45.0	0.35	0.60	340.485	143	256	255	49	75	70	4.0	4.0	N/A	
4 - 1	47.5	0.42	0.71	341.68	143	247	248	54	73	70	4.0	4.0	N/A	1029 - 1059
4 - 2	50.0	0.38	0.65	342.82	143	242	243	61	71	70	4.0	2.9	N/A	Loss power
4 - 3	52.5	0.37	0.63	344.00	143	248	254	60	72	70	4.0	1.9	N/A	
4 - 4	55.0	0.37	0.63	345.12	143	247	257	60	72	70	4.0	1.8	N/A	
4 - 5	57.5	0.31	0.53	346.18	143	255	258	58	74	71	4.0	1.5	N/A	
4 - 6	60.0	0.30	0.51	347.155	143	259	259	57	75	71	4.0	1.5	N/A	
	Total	7.266*	7.520*		1716				880	841				
	Average													

* Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC JV
Date 3-20-14

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TEST LOCATION: Stack HCN TESTING METHOD: OTM 29 PAGE 1 OF 2

UNIT: FCC Regenerator Vent RUN: 8

FIELD DATA SHEET

Client	MARATHON	Project No.	12461
Plant	Garyville, LA	Date	3.21.14
Meter Operator	I. Lopez		
Probe Operator	A. Christensen		

Meter Box	66-21	Sample Box No.	M-2
Meter Y_d	0.9884	Meter $\Delta H_@$	1.7537
K Factor	1.7	Pitot C_p	0.832
Leak Rate Before	0.003 [cfm] [Lpm]	@	17 (in. Hg)
Leak Rate After	0.001 [cfm] [Lpm]	@	15 (in. Hg)
Pitot Leak Check Before: ☑	After: Good ☑	Bad ☐	

Cross-Section of Test Location

Duct Dimensions (in.)	156.0		
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]
0.2	9.25		

Amb. Temp. (°F)	69	Bar. Press.	29.91 (in. Hg) [mbar]
Probe I.D. No.	GTMS-G-10		
Liner Material	Glass		

Filter No.	OTM	29	R-8
Thimble No.	—	N14	—
Nozzle Diameter	0.235	Nozzle I.D.	235-1

Start Time:	8:23	Stop Time:	932

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. (ft) [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points	Filter T_f (°F) Set Points	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
				347.550		250	250							
4-1	2.5	0.38	0.65	348.71	143	255	258	58	69	67	4.0	2.2	N/A	
4-2	5.0	0.40	0.68	349.87	143	256	256	56	70	67	4.0	1.1	N/A	
4-3	7.5	0.40	0.68	351.01	143	257	257	51	72	68	4.0	1.0	N/A	
4-4	10.0	0.38	0.65	352.19	143	256	256	48	74	68	4.0	0.8	N/A	
4-5	12.5	0.31	0.53	353.30	143	253	255	46	74	69	4.0	1.0	N/A	
4-6	15.0	0.30	0.51	354.325	143	256	256	45	74	69	4.0	1.1	N/A	
1-1	17.5	0.39	0.66	355.48	143	252	257	51	74	70	4.0	1.3	N/A	
1-2	20.0	0.40	0.68	356.68	143	252	256	49	75	71	4.0	1.0	N/A	
1-3	22.5	0.43	0.73	357.91	143	254	256	48	77	71	4.0	1.0	N/A	
1-4	25.0	0.41	0.70	359.09	143	256	254	48	78	71	4.0	0.9	N/A	
1-5	27.5	0.36	0.61	360.22	143	255	256	49	78	72	4.0	0.9	N/A	
1-6	30.0	0.35	0.59	361.330	142	256	256	49	79	73	4.0	1.0	N/A	
	Total	7.3469	7.6700	27.1650	1715				844	836				
	Average	0.6042	0.6225		142.9583				75.2417					

Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC TL
Date 3.21.14

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TEST LOCATION: Stack HCN **TESTING** **METHOD:** OTM 29 **PAGE** 2 **OF** 2

UNIT: FCC Regenerator Vent **RUN:** 8

FIELD DATA SHEET

Client	MARATHON	Project No.	0461
Plant	Garyville, LA	Date	3-21-14
Meter Operator	T. Lopez		
Probe Operator	A. Christensen		

Meter Box	66-21	Sample Box No.	M-2
Meter Y_d		Meter $\Delta H_@$	
K Factor		Pitot C_p	
Leak Rate Before	[cfm] [Lpm]	@	(in. Hg)
Leak Rate After	[cfm] [Lpm]	@	(in. Hg)
Pitot Leak Check Before: ☐		After: Good ☐ Bad ☐	

Cross-Section of Test Location

Duct Dimensions (in.)			
Static Pres (in. H_2O)	Port Len. (in.)	Gas Flow [In] [Out] of page	First point all the way [In] [Out]

Amb. Temp. (°F)	69	Bar. Press.	29.91 ~~[in. Hg]~~ [mbar]
Probe I.D. No.	67M5-6-10		
Liner Material	Glass		

Filter No.			
Thimble No.			
Nozzle Diameter		Nozzle I.D.	

Start Time:		Stop Time:	

Traverse Point Number	Min/pt 2.5 Elapsed Time	Velocity Head ΔP (in. H_2O)	Orifice Setting ΔH (in. H_2O)	Gas Sample Volume V_m Init. Vol. [ft³] [L]	Stack Temp. Ts (°F)	Probe T_p (°F) Set Points 250	Filter T_f (°F) Set Points 250	Cond. Temp. T_c (°F)	DGM Inlet $T_{m\,in}$ (°F)	DGM Outlet $T_{m\,out}$ (°F)	Pump Vacuum (in.Hg)	Oxygen Indicator, approx (%,dv)	☐ Amb Filter ☐ Dioxin Trap ☑ N/A	Notes
2-1	32.5	0.38	0.65	362.490	143	254	255	54	79	73	4.0	1.2	N/A	
2-2	35.0	0.40	0.68	363.64	143	253	256	53	79	74	4.0	1.2	N/A	
2-3	37.5	0.38	0.65	364.77	143	253	256	54	80	74	4.0	1.1	N/A	
2-4	40.0	0.37	0.63	365.95	143	249	257	54	81	75	4.0	1.1	N/A	
2-5	42.5	0.32	0.54	367.05	143	256	256	55	82	75	3.5	1.2	N/A	
2-6	45.0	0.30	0.51	368.09	143	261	258	56	82	76	3.5	1.4	N/A	
3-1	47.5	0.39	0.66	369.26	143	252	256	60	80	76	4.0	1.4	N/A	
3-2	50.0	0.40	0.68	370.48	143	250	255	59	82	77	4.0	1.3	N/A	
3-3	52.5	0.42	0.71	371.59	143	254	253	59	82	77	4.0	1.2	N/A	
3-4	55.0	0.29	0.49	372.65	143	257	255	57	83	77	3.5	1.3	N/A	
3-5	57.5	0.31	0.53	373.660	143	255	254	57	82	77	3.5	1.3	N/A	
3-6	60.0	0.32	0.54	374.715	143	253	255	57	83	78	3.5	1.2		
	Total	7.1530	7.2700		1716				975	909.				
	Average													

* Sum of square roots.

Circle correct bracketed units on data sheet.

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QA/QC [signature]
Date 3-21-14

FDS005-General.xls, December 2006
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Impinger Weight Sheet

Client Marathon		Unit Name/Location	FCCU Regenerator Vent
Plant Garyville	Job No. 12461	Method	USEPA M-5/202

Balance Calibration Check			
Balance ID	67-1B-6	Reference Weight Mass	500g
Reference Weight ID	100001648	Reference Weight Reading	499.87

Check must be performed once per day. Reference Weight Mass must agree with Reference Weight Reading to within ±0.5 g.

Run No. 4	Filter Type Tared Quartz Fiber	TFE Membrane	Sample Box No. 202-6
Date 3/19/14	Lot No. 45475	6606-43	pH N/A
Analyst SL	Filter No. ~~45474~~ SL 3/19/14	N/A	Rinse 0 mL

	Contents	~~Gross~~ Net Weight (gm)	Tare Weight (gm)	~~Net~~ Gross Weight Gain (gm)	
Impinger 1	Empty	171.2	402.5	~~593.6~~ 573.7	
Impinger 2	Empty	4.7	~~460.8~~ 458.5	463.2	QA/QC SL
Impinger 3	100 mL DI H_2O	22.1	648.8	670.9	Date 3/19
Impinger 4	Silica Gel	13.1	728.7	741.8	
					Total Weight (gm)
					198.0
					211.1

Run No. 5	Filter Type Tared Quartz Fiber	TFE Membrane	Sample Box No. 202-7
Date 3/19/14	Lot No.	6606-44	pH N/A
Analyst SL	Filter No. 45476	N/A	Rinse 0 mL

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	Empty	596.8	448.7	148.1	
Impinger 2	Empty	447.3	441.3	6.0	QA/QC SL
Impinger 3	100 mL DI H_2O	574.8	544.8	30.0	Date 3/19
Impinger 4	Silica Gel	685.0	666.3	18.7	
					Total Weight (gm)
					184.1
					202.8

Run No. 6	Filter Type Tared Quartz Fiber	TFE Membrane	Sample Box No.
Date 3/20/14	Lot No.	6606-45	pH N/A
Analyst JCM	Filter No. ~~45~~ 45477	N/A	Rinse 0 mL

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	Empty	~~617.8~~ 598.1	419.3	178.8	
Impinger 2	Empty	447.1	445.9	1.2	QA/QC SL
Impinger 3	100 mL DI H_2O	580.1	557.8	~~25.3~~ 22.3 DM 3/28	Date 3/20
Impinger 4	Silica Gel	722.2	707.5	14.7	
					Total Weight (gm)
					~~205.3~~ 202.3 DM 3/2
					220.0 217.00 DM 3/28

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QA/QC SL
Date 3/20/14

ImpFieldWtSht_200406a
12461 ImpFieldWtSht.xls
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Impinger Weight Sheet

Client Marathon		Unit Name/Location FCCU Regenerator Vent
Plant Garyville	Job No. 12461	Method USEPA M-5/202

Balance Calibration Check			
Balance ID	57-1B-6	Reference Weight Mass	500 g
Reference Weight ID	10000 16488	Reference Weight Reading	499.9 g

Check must be performed once per day. Reference Weight Mass must agree with Reference Weight Reading to within ±0.5 g.

Run No. 1	Filter Type Tared Quartz Fiber	TFE Membrane	Sample Box No. 202-6
Date 3/18/14	Lot No.	*6606-27	pH N/A
Analyst ~~SL~~ JCM	Filter No. 45472	N/A	Rinse 0 mL

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	Empty	~~371.5572~~	400.5	176.7	
Impinger 2	Empty	500.8	~~to~~ 460.1	40.7	QA/QC SL
Impinger 3	100 mL DI H_2O	665.4	648.3	17.1	Date 7/18
Impinger 4	Silica Gel	729.1	713.1	16.0	
					Total Weight (gm)

Run No. 2	Filter Type Tared Quartz Fiber	TFE Membrane	Sample Box No. 202-7
Date 3/19/14	Lot No.	6606-28	pH N/A
Analyst SL	Filter No. 45473	N/A	Rinse 0 mL

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	Empty	599.9	427.0	172.9	
Impinger 2	Empty	460.4	439.8	20.6	QA/QC SL
Impinger 3	100 mL DI H_2O	571.4	543.7	27.7	Date 3/19
Impinger 4	Silica Gel	666.9	654.0	12.9	
					Total Weight (gm)
					221.2
					234.1

Run No. 3	Filter Type Tared Quartz Fiber	TFE Membrane	Sample Box No. 202-3
Date 3/19/14	Lot No.	*6606-29	pH N/A
Analyst SL	Filter No. 45474	N/A	Rinse 0 mL

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	Empty	590.00	418.3	171.7	
Impinger 2	Empty	453.7	443.8	9.9	QA/QC SL
Impinger 3	100 mL DI H_2O	577.5	553.3	24.2	Date 3/19
Impinger 4	Silica Gel	707.5	688.2	19.3	
					Total Weight (gm)
					205.8
					225.1

* 060911-T11613

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ImpFieldWtSht_200405e
12461 ImpFieldWtSht.xls
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QA/QC SL
Date 3/19/14

Impinger Weight Sheet

Client Marathon		Unit Name/Location	FCCU Regenerator Vent
Plant Garyville	Job No. 12461	Method	USEPA OTM-29

Balance Calibration Check			
Balance ID		Reference Weight Mass	
Reference Weight ID		Reference Weight Reading	

Check must be performed once per day. Reference Weight Mass must agree with Reference Weight Reading to within ±0.5 g.

Run No. ~~1~~ ~~3~~ 4	Filter Type Quartz Fiber		Sample Box No. M3
Date 3/19/14	Lot No.		pH 11, 12, 13, 13, 13
Analyst JCM	Filter No. N/A		Rinse 1

	Contents	~~Gross Weight (gm)~~ Net	Tare Weight (gm)	~~Net Weight Gain (gm)~~ Gross	
Impinger 1	~~Empty~~ 200 mL 6N NaOH	110.4	649.6	760.0	
Impinger 2	200 mL 6N NaOH	16.3	~~631.1~~ 651.5	667.8	QA/QC SL
Impinger 3	200 mL 6N NaOH	22.0	656.2	678.2	Date 3/19
Impinger 4	200 mL 6N NaOH	12.7	~~644.2~~ 636.5	649.2	
Impinger 5	100 mL 6N NaOH	7.7	533.6	541.3	Total Weight (gm)
Impinger 6	Silica Gel	4.9	666.2	671.1	~~161.4~~ 169.1 DM
					~~169.1~~ 174.0 3/2

Run No. ~~2~~ 3	Filter Type Quartz Fiber		Sample Box No. M2
Date 3/19/14	Lot No.		pH 11, 11, 12, 13, 13
Analyst JCM	Filter No. N/A		Rinse

impinger 182 + 70g 6N NaOH
384 + 0g 6N NaOH

	Contents	~~Gross~~ Net Weight (gm)	Tare Weight (gm)	~~Net~~ Gross Weight Gain (gm)	
Impinger 1	~~Empty~~ 200 mL 6N NaOH	152.0	653.5	805.5	
Impinger 2	200 mL 6N NaOH	44.0	647.6	691.6	QA/QC SL
Impinger 3	200 mL 6N NaOH	23.1	622.8	645.9	Date 3/19
Impinger 4	200 mL 6N NaOH	18.4	633.3	651.7	
Impinger 5	100 mL 6N NaOH	8.9	542.6	551.5	Total Weight (gm)
Impinger 6	Silica Gel	4.8	752.8	757.6	~~237.5~~ 246.4 DM
					~~246.4~~ 251.2 3/28

Run No. ~~3~~ 5	Filter Type Quartz Fiber		Sample Box No. M2
Date 3/19/14	Lot No.		pH 11, 11, 13, 13, 13
Analyst JCM	Filter No. N/A		Rinse

35.5 g 6N NaOH add to impi 182

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	~~Empty~~ 200 mL 6N NaOH	819.9	~~57~~ 654.4	165.5	
Impinger 2	200 mL 6N NaOH	687.6	648.4	39.2	QA/QC SL
Impinger 3	200 mL 6N NaOH	653.2	632.9	20.3	Date 3/19
Impinger 4	200 mL 6N NaOH	648.3	632.1	16.2	
Impinger 5	100 mL 6N NaOH	542.0g	534.9	7.1	Total Weight (gm)
Impinger 6	Silica Gel	762.7	757.1	5.6	~~241.2~~ 248.3 DM
					~~248.3~~ 253.9 3/28

SL 3/19/14

QA/QC SL
Date 3/19/14

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12461 ImpFieldWISht.xls
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Impinger Weight Sheet

Client Marathon		Unit Name/Location FCCU Regenerator Vent
Plant Garyville	Job No. 12461	Method USEPA OTM-29

Balance Calibration Check			
Balance ID		Reference Weight Mass	SFE M4 2.2
Reference Weight ID		Reference Weight Reading	

Check must be performed once per day. Reference Weight Mass must agree with Reference Weight Reading to within ±0.5 g.

Run No. 1	Filter Type Quartz Fiber	Sample Box No. M3
Date 3/18/14	Lot No.	pH 10,10,10,11
Analyst JCM	Filter No. N/A	Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
~~Impinger 1~~	~~Empty~~ N/A				
Impinger 2	200 mL 6N NaOH	814.8	666.7	148.1	QA/QC K
Impinger 3	200 mL 6N NaOH	724.1	655.1	69.0	Date 3/18
Impinger 4	200 mL 6N NaOH	671.3	645.4	25.9	
Impinger 5	100 mL 6N NaOH pH-12	544.6	531.8	12.8	Total Weight (gm)
Impinger 6	Silica Gel	666.5	657.5	9.0	255.8
					264.8

Run No. 2	Filter Type Quartz Fiber	Sample Box No.
Date	Lot No.	pH
Analyst	Filter No. N/A	Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	Empty				
Impinger 2	200 mL 6N NaOH		621.8		QA/QC
Impinger 3	200 mL 6N NaOH		~~645.8~~ 647.0		Date
Impinger 4	200 mL 6N NaOH		~~629.3~~ 630.5		
Impinger 5	100 mL 6N NaOH	Back Flushed	~~540.9~~ 542.2		Total Weight (gm)
Impinger 6	Silica Gel		773.6		

Run No. 2	Filter Type Quartz Fiber	Sample Box No. M2
Date 3/18/17	Lot No.	pH 12,12,12,12,12
Analyst JCM	Filter No. N/A	Rinse NA

	Contents	~~Gross Weight~~ Net (gm)	Tare Weight (gm)	~~Net Weight Gain~~ Gross (gm)	
Impinger 1	~~Empty~~ 200 mL 6N NaOH	199.7	658.4	858.1	
Impinger 2	200 mL 6N NaOH	42.3	549.6	591.9	QA/QC SL
Impinger 3	200 mL 6N NaOH	32.0	626.5	658.5	Date 3/19/14
Impinger 4	200 mL 6N NaOH	26.6	644.8	671.4	
Impinger 5	100 mL 6N NaOH	27.0	~~643.7~~ 644.8	671.8	Total Weight (gm)
Impinger 6	Silica Gel	5.6	749.0	754.6	~~300.6~~ 327.6 D.M 3/25
					~~327.6~~ 333.2 D.M

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Impinger Weight Sheet

Client Marathon			Unit Name / Location FCCU Regenerator Vent
Plant Cory ville	Job No. 12461		Method USEPA OTM-27

Balance Calibration Check			
Balance ID		Reference Weight Mass	
Reference Weight ID		Reference Weight Reading	

Check must be performed at least Once per Method per Job

Reference Weight Mass must agree with Reference Weight Reading to within ±0.5 g.

Run No. 6	Filter Type Quartz Filter		Sample Box No. M3
Date 3/19/14	Lot No.		pH 10, 13, 13, 13, 13
Analyst JCM	Filter No.		Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	~~Net Weight Gain (gm)~~
Impinger 1	200mL 6N NaOH	823.3	656.3	~~165.5~~ 167.0 Dm 3/28
Impinger 2	" "	672.1	635.1	~~35.2~~ 37.0
Impinger 3	" "	685.6	662.2	~~23.4~~ ~~20.3~~ ~~3/24/14~~
Impinger 4	" "	684.0	648.5	~~40.5~~ ~~23.1~~ 3/20/14 → 23.4 → 35.5 Dm 3/28
Impinger 5	100mL 6N NaOH		536.7	~~40.5~~
Impinger 6	Silica Gel		769.8	
Impinger 7				

QA/QC	
Date	

Total Weight (gm)

When impinger 1 was added to 2, impinger 2 pH was 12

Run No. 8	Filter Type Quartz Filter		Sample Box No. M2
Date 3/20	Lot No.		pH ~~10, 13, 13, 13, 13~~ 10, 11, 13, 13, 13
Analyst	Filter No.		Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)
Impinger 1	200mL 6N NaOH	780.8	646.7	
Impinger 2	" "	717.3	648.5	
Impinger 3	" "	654.4	624.7	
Impinger 4	" "	658.5	637.7	
Impinger 5	100mL 6N NaOH	546.2	~~637.7~~ 535.6	
Impinger 6	Silica Gel			
Impinger 7				

QA/QC	
Date	

Total Weight (gm)

Run No. ~~8~~ SC 3/24 7	Filter Type Quartz Filter		Sample Box No. M3
Date 3/20/14	Lot No.		pH 11, 13, 13, 13, 13
Analyst JCM	Filter No.		Rinse

When impinger 1 was added to impinger 2 pH was 12

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)
Impinger 1	200mL 6N NaOH	799.3	659.6	139.7
Impinger 2	" "	668.1	637.4	30.7
Impinger 3	" "	679.9	662.0	17.9
Impinger 4	" "	656.9	636.9	~~20.9~~ 20.0 Dm 3/28
Impinger 5	100mL 6N NaOH	560.6	557.6	3.0
Impinger 6	Silica Gel	778.6	775.9	2.7
Impinger 7				

QA/QC SC
Date 3/20/14

Total Weight (gm)
~~214.2~~ 211.3 Dm 3/28
~~212.2~~ 214.0

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QA/QC SC
Date 3/24/14

FD0004B ImpingerWt.xls, August 2004
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Impinger Weight Sheet

Client Marathon		Unit Name/Location FCCU Regenerator Vent
Plant Garyville	Job No. 12461	Method USEPA M-8

Balance Calibration Check			
Balance ID		Reference Weight Mass	
Reference Weight ID		Reference Weight Reading	

Check must be performed once per day. Reference Weight Mass must agree with Reference Weight Reading to within ±0.5 g.

Run No. 1	Filter Type Quartz Fiber	Sample Box No. M7
Date 3/20/14	Lot No.	pH N/A
Analyst JCM	Filter No. N/A	Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)
Impinger 1	100 mL 80% Isopropanol	635.5	540.7	94.8
Impinger 2	100 mL ~~3% H_2O_2~~ DI	594.2	541.0	53.2
Impinger 3	100 mL ~~3% H_2O_2~~ DI	575.2	542.6	32.6
Impinger 4	Silica Gel	696.9	666.1	30.8

QA/QC
Date

Total Weight (gm)
180.6
211.4

Run No. 2	Filter Type Quartz Fiber	Sample Box No. M5
Date 3/20/14	Lot No.	pH N/A
Analyst JCM	Filter No. N/A	Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)
Impinger 1	100 mL 80% Isopropanol	607.2	515.0	92.2
Impinger 2	100 mL 3% ~~H_2O_2~~ DI	616.3	562.2	54.1
Impinger 3	100 mL 3% ~~H_2O_2~~ DI	685.9	649.6	36.3
Impinger 4	Silica Gel	816.8	777.1	39.7

QA/QC SL
Date 3/21

Total Weight (gm)
182.6
222.3

Run No. 3	Filter Type Quartz Fiber	Sample Box No. M7
Date 3/21/14	Lot No.	pH N/A
Analyst JCM	Filter No. N/A	Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)
Impinger 1	100 mL 80% Isopropanol	633.3	550.4	82.9
Impinger 2	100 mL 3% H_2O_2	599.6	535.5	64.1
Impinger 3	100 mL 3% H_2O_2	579.0	544.6	34.4
Impinger 4	Silica Gel	717.8	696.7	21.1

QA/QC SL
Date 3/21

Total Weight (gm)
181.4
202.5

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QA/QC SL
Date 3/21/14

Impinger Weight Sheet

Client Marathon		Unit Name/Location FCCU Regenerator Vent
Plant Garyville	Job No. 12461	Method USEPA M-8

Balance Calibration Check			
Balance ID		Reference Weight Mass	
Reference Weight ID		Reference Weight Reading	

Check must be performed once per day. Reference Weight Mass must agree with Reference Weight Reading to within ±0.5 g.

Run No. R4	Filter Type Quartz Fiber	Sample Box No. M5
Date 3/20/14	Lot No.	pH N/A
Analyst JRM	Filter No. N/A	Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)
Impinger 1	100 mL 80% Isopropanol	602.4	516.8	85.6
Impinger 2	100 mL 3% H_2O_2	624.6	562.6	62.0
Impinger 3	100 mL 3% H_2O_2	690.6	651.3	39.3
Impinger 4	Silica Gel	845.6	816.6	29.0

QA/QC SL
Date 3/21

Total Weight (gm)
186.9
215.9

Run No. R5	Filter Type Quartz Fiber	Sample Box No. M7
Date 3/21/14	Lot No.	pH N/A
Analyst JRM	Filter No. N/A	Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)
Impinger 1	100 mL 80% Isopropanol	667.2	548.6	118.6
Impinger 2	100 mL 3% H_2O_2	597.0	536.1	60.9
Impinger 3	100 mL 3% H_2O_2	574.1	544.5	~~19.6~~ 29.6 DM 3/28
Impinger 4	Silica Gel	767.2	735.8	31.4

QA/QC SL
Date 3/21

Total Weight (gm)
~~199.1~~ 209.1 DM 3/28
230.5 240.5 DM 3/28

Run No. R6	Filter Type Quartz Fiber	Sample Box No.
Date 3/21/14	Lot No.	pH N/A
Analyst JCM	Filter No. N/A	Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)
Impinger 1	100 mL 80% Isopropanol	605.7	553.9	51.8
Impinger 2	100 mL 3% H_2O_2	648.7	563.7	85.0
Impinger 3	100 mL 3% H_2O_2	687.3	653.0	34.3
Impinger 4	Silica Gel	860.0	845.0	15.0

QA/QC
Date

Total Weight (gm)
171.1
186.1

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QA/QC SL
Date 3/24/14

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12461 ImpFieldWtSht.xls
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INSTRUMENTAL O_2 / CO_2 DATA

TEST LOCATION: FCCU Regenerator Stack **PAGE** 1 **OF** 3

Client	Marathon	Project Number	12461	$Fo = \frac{20.9 - \%O_2}{\%CO_2}$
Plant	Garyville, LA	Unit		
Asset No(s)		Fuel Type	N/A	Leak Check Passed ☐

Gas	Cylinder ID No.	Gas Concentration (%dv)	Expiration Date
Zero	alm10791-0114	0.00 / 0.00	
O_2 / CO_2	alm23687-1013	9.05 / 9.14	
O_2 / CO_2	alm51631-0710	4.54 / 19.00	

Pre-Test Calibration Response

	Oxygen		Carbon dioxide	
	(%, dv)	Cal Error	(%, dv)	Cal Error
Zero	0.0	0.0%	0.0	0.0%
High	9.1	0.6%	19.1	0.5%
Mid	4.5	-0.4%	9.0	-0.7%

Note: Pre-test instrument response criteria is based on Method 3A, calibration error. Response to zero, high, and mid gases must be ± 2% of scale. Instrument scale is considered to be the highest calibration gas value.

Field Data

Run Number	Method Number		Percent O_2	Percent CO_2	Fo	Analyst	Analysis Date	Analysis Time	Md lb/lb•mole
1	5/202		N/A	N/A	N/A				#VALUE!
1	OTM29		2.7	13.5	N/A		03/18/14	13:15	30.27
2	5/202		2.3	17.4	N/A		03/18/14	20:03	30.88
2	OTM29		2.9	13.8	N/A		03/18/14	20:07	30.32
3	5/202								
3	OTM29								
4	5/202								
4	OTM29								
5	5/202								
5	OTM29								
6	5/202								
6	OTM29								

Post-Test Calibration Response

	Oxygen			Carbon dioxide		
	(%, dv)	Cal Error	Drift	(%, dv)	Cal Error	Drift
Zero	0.0	0.0%	0.0%	0.0	0.0%	0.0%
High						
Mid	4.4	-1.5%	-1.1%	8.9	-1.3%	-0.5%

Note: Post-test instrument response criteria is based on Method 3A, drift. Response to zero, high, and mid gases must not drift more than ± 3% of scale. Instrument scale is considered to be the highest calibration gas value.

Calculate Fo to verify results. Acceptable ranges for Fo:

Coal: Anthracite and Lignite	1.016-1.130	Gas: Natural	1.600-1.836
Bituminous	1.083-1.230	Propane	1.434-1.586
Oil: Distillate	1.260-1.413	Butane	1.405-1.553
Residual	1.210-1.370	Wood	1.000-1.120
Municipal Solid Waste	1.030-1.300	Wood Bark	1.003-1.130

QA/QC_____
Date_____

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INSTRUMENTAL O_2 / CO_2 DATA

TEST LOCATION: FCCU Regenerator Stack **PAGE** 2 **OF** 3

Client	Marathon	Project Number	12461	$Fo = \frac{20.9 - \%O_2}{\%CO_2}$
Plant	Garyville, LA	Unit		
Asset No(s)		Fuel Type	N/A	Leak Check Passed ☐

Gas	Cylinder ID No.	Gas Concentration (%dv)	Expiration Date
Zero	alm10791-0114	0.00 / 0.00	
O_2 / CO_2	alm23687-1013	9.05 / 9.14	
O_2 / CO_2	alm51631-0710	4.54 / 19.00	

Pre-Test Calibration Response

	Oxygen		Carbon dioxide	
	(%, dv)	Cal Error	(%, dv)	Cal Error
Zero	0.0	-0.1%	0.0	-0.1%
High	9.0	-0.1%	19.1	0.4%
Mid	4.5	-0.1%	9.1	-0.4%

Note: Pre-test instrument response criteria is based on Method 3A, *calibration error*. Response to zero, high, and mid gases must be ± 2% of scale. Instrument scale is considered to be the highest calibration gas value.

Field Data

Run Number	Method Number		Percent O_2	Percent CO_2	Fo	Analyst	Analysis Date	Analysis Time	Md lb/lb•mole
3	5/202		2.3	17.5	N/A		03/19/14	11:22	30.89
3	OTM29		3.7	11.7	N/A		03/19/14	11:25	30.02
4	5/202		4.3	15.1	N/A		03/19/14	12:56	30.59
4	OTM29		10.0	7.0	N/A		03/19/14	12:53	29.52
5	5/202		2.8	16.8	N/A		03/19/14	15:17	30.80
5	OTM29		2.3	12.5	N/A		03/19/14	15:19	30.09
6	5/202		1.4	17.9	N/A		03/19/14	17:31	30.92
6	OTM29		1.8	13.0	N/A		03/19/14	17:29	30.15

Post-Test Calibration Response

	Oxygen			Carbon dioxide		
	(%, dv)	Cal Error	Drift	(%, dv)	Cal Error	Drift
Zero						
High						
Mid						

Note: Post-test instrument response criteria is based on Method 3A, drift. Response to zero, high, and mid gases must not drift more than ± 3% of scale. Instrument scale is considered to be the highest calibration gas value.

Calculate Fo to verify results. Acceptable ranges for Fo:

Coal: Anthracite and Lignite	1.016-1.130	Gas: Natural	1.600-1.836
Bituminous	1.083-1.230	Propane	1.434-1.586
Oil: Distillate	1.260-1.413	Butane	1.405-1.553
Residual	1.210-1.370	Wood	1.000-1.120
Municipal Solid Waste	1.030-1.300	Wood Bark	1.003-1.130

QA/QC_____

Date_____

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INSTRUMENTAL O_2 / CO_2 DATA

TEST LOCATION: FCCU Regenerator Stack **PAGE** 3 **OF** 3

Client	Marathon	Project Number	12461	$Fo = \frac{20.9 - \%O_2}{\%CO_2}$
Plant	Garyville, LA	Unit		
Asset No(s)		Fuel Type	N/A	Leak Check Passed ☐

Gas	Cylinder ID No.	Gas Concentration (%dv)	Expiration Date
Zero	alm10791-0114	0.00 / 0.00	
O_2 / CO_2	alm23687-1013	9.05 / 9.14	
O_2 / CO_2	alm51631-0710	4.54 / 19.00	

Pre-Test Calibration Response

	Oxygen		Carbon dioxide	
	(%, dv)	Cal Error	(%, dv)	Cal Error
Zero				
High				
Mid				

Note: Pre-test instrument response criteria is based on Method 3A, calibration error. Response to zero, high, and mid gases must be ± 2% of scale. Instrument scale is considered to be the highest calibration gas value.

Field Data

Run Number	Method Number		Percent O_2	Percent CO_2	Fo	Analyst	Analysis Date	Analysis Time	Md lb/lb•mole
1	8		2.8	17.1	N/A	SL	03/20/14	11:10	30.85
7	OTM29		3.6	11.3	N/A	SL	03/20/14	11:25	29.95
2	8		1.9	17.8	N/A	sl	03/20/14	15:42	30.92
3	8		1.7	18.0	N/A	SL	03/20/14	15:44	30.95
4	8		2.0	17.5	N/A	sl	03/21/14	11:47	30.88
8	OTM29		2.3	13.4	N/A	sl	03/21/14	11:45	30.24
5	8		2.1	17.7	N/A	sl	03/21/14	11:50	30.92
6	8		1.6	18.0	N/A	sl	03/21/14	14:08	30.94

Post-Test Calibration Response

	Oxygen			Carbon dioxide		
	(%, dv)	Cal Error	Drift	(%, dv)	Cal Error	Drift
Zero						
High						
Mid						

Note: Post-test instrument response criteria is based on Method 3A, drift. Response to zero, high, and mid gases must not drift more than ± 3% of scale. Instrument scale is considered to be the highest calibration gas value.

Calculate Fo to verify results. Acceptable ranges for Fo:

Coal:	Anthracite and Lignite	1.016-1.130	Gas:	Natural	1.600-1.836
	Bituminous	1.083-1.230		Propane	1.434-1.586
Oil:	Distillate	1.260-1.413		Butane	1.405-1.553
	Residual	1.210-1.370	Wood		1.000-1.120
Municipal Solid Waste		1.030-1.300	Wood Bark		1.003-1.130

QA/QC_____

Date_____

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Time	Pressure Reading (Guage 1 -Steam Traced)	Pressure Reading (Guage 2)
9:39	2 psi	3 psi
10:30	2 psi	3 psi
11:30	2 psi	3 psi
13:00	2.5 psi	3 psi
18:20	3 psi	3.5 psi
19:15	2.5 psi	3 psi

Date 3/18/14

Test Condition 1

Name Scott Lehmann

Signature

Time	Pressure Reading (Guage 1 -Steam Traced)	Pressure Reading (Guage 2)
11:55	2.5 psi	3.5 psi
14:30	3.0 psi	3.5 psi
15:25	3.0 psi	3.5 psi
16:42	3.0 psi	3.5 psi

Date 3/19/14

Test Condition #2

Name Scott Lehmann

Signature

Time	Pressure Reading (Guage 1 -Steam Traced)	Pressure Reading (Guage 2)
09:05	2.5 psi	3.5 psi
11:35	3.5 psi	3.5 psi
12:30	3 psi	3.5 psi
13:30	2.5 psi	3.5 psi
14:23	2.5 psi	3.5 psi

Date 3/20/14

Test Condition 2

Name Scott Lehmann

Signature

Time	Pressure Reading (Guage 1 -Steam Traced)	Pressure Reading (Guage 2)
08:36	2psi	3psi
09:17	2psi	3psi
10:35	2.5psi	3.5psi
11:21	2.5psi	3.5psi
14:34	3psi	3.5psi

Date 3/21/14

Test Condition 1

Name Scott Lehmann

Signature

FIELD DATA PRINTOUTS

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I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: PWK

Date: 05/14

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USEPA Method 3 Laboratory Data

Test Method: USEPA Method 5/202
Analyte: Particulate/CPM

Location: FCCU Regenerator Vent
Client: Marathon
Project No: 12461
Method: EPA Method 3A
Fuel Type: Select Fuel
F_o for Fuel: N/A

Analyst: S. Lehmann
Analyst Emp No: 514

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
1	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		17.45000		2.30000	80.25000	30.88400	1.06590	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
2	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		17.40000		2.30000	80.30000	30.87600	1.06897	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
3	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		17.50000		2.30000	80.20000	30.89200	1.06286	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis:
	1							
	2							
	3							
	Avg.							
CEM or Other Avg:								☐ Fo value within expected range.

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USEPA Method 4 Laboratory Data

Location: FCCU Regenerator Vent
Client: Marathon
Project No: 12461

Test Method: USEPA Method 5/202
Analyte: Particulate/CPM
Analyst: S. Lehmann
Analyst Emp No: 514

Test Run: 1

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	577.2	400.5	176.7
Impinger 2	Empty	500.8	460.1	40.7
Impinger 3	DI Water	665.4	648.3	17.1
Impinger 4	Silica Gel	729.1	713.1	16.0
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
234.5	Liquid (gm)		
0.0	less rinse (gm)		
234.5	Net Liquid (gm)	234.5	☑ QA/QC OK
+ 16.0	Silica Gel (gm)	16.0	☑ QA/QC OK
250.5	Total Vlc (gm)	250.5	☑ QA/QC OK

Test Run: 2

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	599.9	427.0	172.9
Impinger 2	Empty	460.4	439.8	20.6
Impinger 3	DI Water	571.4	543.7	27.7
Impinger 4	Silica Gel	666.9	654.0	12.9
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
221.2	Liquid (gm)		
0.0	less rinse (gm)		
221.2	Net Liquid (gm)	221.2	☑ QA/QC OK
+ 12.9	Silica Gel (gm)	12.9	☑ QA/QC OK
234.1	Total Vlc (gm)	234.1	☑ QA/QC OK

Test Run: 3

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	590.0	418.3	171.7
Impinger 2	Empty	453.7	443.8	9.9
Impinger 3	DI Water	577.5	553.3	24.2
Impinger 4	Silica Gel	707.5	688.2	19.3
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
205.8	Liquid (gm)		
0.0	less rinse (gm)		
205.8	Net Liquid (gm)	205.8	☑ QA/QC OK
+ 19.3	Silica Gel (gm)	19.3	☑ QA/QC OK
225.1	Total Vlc (gm)	225.1	☑ QA/QC OK

Test Run:

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty			
Impinger 2	Empty			
Impinger 3	DI Water			
Impinger 4	Silica Gel			
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
	Liquid (gm)		
	less rinse (gm)		
	Net Liquid (gm)		☐ QA/QC OK
	Silica Gel (gm)		☐ QA/QC OK
	Total Vlc (gm)		☐ QA/QC OK

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Field Data Printout

Test Method: USEPA Method 5/202
Analyte: Particulate/CPM

Location: FCCU Regenerator Vent
Test Run: 1
Client: Marathon
Project No: 12461
Source Area (ft^2): 132.73229
Meter Operator: M. LeResche 624
Probe Operator: A. Christiansen 534
Test Date: 3/18/14
Start Time: 10:45
Stop Time: 12:01
Leak Rate Before: 0.002 cfm @ 15 "Hg
Leak Rate After: 0.001 cfm @ 12 "Hg

Bar. Press. (in. Hg): 29.76
Static P: 0.2
O_2 (dry volume %): 2.30 ☑ Pass ☐ Fail
CO_2 (dry volume %): 17.45
N_2+CO (dry volume %): 80.25
H_2O (condensate, ml or gm): 234.5
H_2O (silica, g): 16.0
Actual Moisture (%): 21.98

Nozzle ID No: 276-1
Nozzle Diameter (D_n): 0.276
Probe ID No: 67-6-1
Pitot C_p: 0.831
Pitot Leak Check:
Meter Box ID. No: 66-24
Meter ΔH@: 1.74760
Meter Y_d: 0.99310

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			521.467						
2-01	2.5	0.40	1.47	523.080	144	64	64	0.63	1.61	99.7
2-02	5.0	0.40	1.47	524.680	144	64	64	0.63	1.60	98.9
2-03	7.5	0.40	1.47	526.390	144	65	64	0.63	1.71	105.6
2-04	10.0	0.40	1.47	527.840	143	68	63	0.63	1.45	89.3*
2-05	12.5	0.35	1.28	529.350	143	70	64	0.59	1.51	99.1
2-06	15.0	0.28	1.03	530.791	143	72	64	0.53	1.44	105.5
1-01	17.5	0.40	1.47	532.290	144	73	66	0.63	1.50	91.7
1-02	20.0	0.40	1.47	533.960	143	74	66	0.63	1.67	102.0
1-03	22.5	0.40	1.47	535.400	144	76	66	0.63	1.44	87.8*
1-04	25.0	0.37	1.36	536.840	144	78	67	0.61	1.44	91.1
1-05	27.5	0.30	1.10	538.240	144	79	67	0.55	1.40	98.2
1-06	30.0	0.28	1.03	539.541	143	79	68	0.53	1.30	94.2
4-01	32.5	0.40	1.47	541.130	144	76	68	0.63	1.59	96.8
4-02	35.0	0.40	1.47	542.760	144	78	68	0.63	1.63	99.1
4-03	37.5	0.40	1.47	544.390	145	80	69	0.63	1.63	98.9
4-04	40.0	0.37	1.36	546.000	145	81	69	0.61	1.61	101.4
4-05	42.5	0.30	1.10	547.520	145	82	69	0.55	1.52	106.2
4-06	45.0	0.26	0.96	548.912	145	81	69	0.51	1.39	104.5
3-01	47.5	0.40	1.47	550.580	145	76	70	0.63	1.67	101.5
3-02	50.0	0.42	1.55	552.160	145	79	70	0.65	1.58	93.5
3-03	52.5	0.42	1.55	553.860	145	81	70	0.65	1.70	100.5
3-04	55.0	0.45	1.66	555.570	145	82	70	0.67	1.71	97.6
3-05	57.5	0.40	1.47	557.310	145	83	71	0.63	1.74	105.0
3-06	60.0	0.30	1.10	558.885	144	84	71	0.55	1.58	109.5
Final	60.0		1.36320	37.41800	144.16667	71.70833		0.60733	37.41800	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6073	1.3633	37.4180	144.1667	71.0833				

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Field Data Printout

			Test Method:	USEPA Method 5/202	
Location:	FCCU Regenerator Vent		Analyte:	Particulate/CPM	
Test Run:	2				
Client:	Marathon		Bar. Press. (in. Hg):	29.76	Nozzle ID No: 275-1
Project No:	12461		Static P:	0.2	Nozzle Diameter (D_n): 0.275
Source Area (ft^2):	132.73229		O_2 (dry volume %):	2.30 ☑ Pass ☐ Fail	Probe ID No: 67-6-1
Meter Operator:	M. LeResche	624	CO_2 (dry volume %):	17.40	Pitot C_p: 0.831
Probe Operator:	A. Christiansen	534	N_2+CO (dry volume %):	80.30	Pitot Leak Check:
Test Date:	3/18/14				
Start Time:	17:56				
Stop Time:	19:09		H_2O (condensate, ml or gm):	221.2	Meter Box ID. No: 66-24
Leak Rate Before:	0.001 cfm	@ 16 "Hg	H_2O (silica, g):	12.9	Meter ΔH@: 1.74760
Leak Rate After:	0.001 cfm	@ 11 "Hg	Actual Moisture (%):	22.07	Meter Y_d: 0.99310

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s ($in. H_2O$)	Sample ΔH ($in. H_2O$)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}\ H_2O$)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			559.509						
3-01	2.5	0.41	1.48	561.270	144	77	78	0.64	1.76	105.7
3-02	5.0	0.41	1.48	562.980	144	77	78	0.64	1.71	102.6
3-03	7.5	0.42	1.52	564.660	144	76	77	0.65	1.68	99.8
3-04	10.0	0.40	1.45	566.330	144	77	77	0.63	1.67	101.6
3-05	12.5	0.34	1.23	567.940	144	77	76	0.58	1.61	106.2
3-06	15.0	0.30	1.09	569.472	144	77	75	0.55	1.53	107.7
4-01	17.5	0.40	1.45	571.100	144	75	75	0.63	1.63	99.4
4-02	20.0	0.40	1.45	572.770	144	77	75	0.63	1.67	101.7
4-03	22.5	0.40	1.45	574.460	144	79	74	0.63	1.69	102.9
4-04	25.0	0.37	1.34	576.120	144	79	74	0.61	1.66	105.0
4-05	27.5	0.30	1.09	577.390	144	81	74	0.55	1.27	89.0*
4-06	30.0	0.25	0.91	579.085	143	81	74	0.50	1.70	130.0*
1-01	32.5	0.40	1.45	580.740	145	76	74	0.63	1.65	101.1
1-02	35.0	0.41	1.48	582.090	144	78	74	0.64	1.35	81.2*
1-03	37.5	0.42	1.52	584.140	145	80	74	0.65	2.05	121.8*
1-04	40.0	0.37	1.34	585.810	145	82	74	0.61	1.67	105.5
1-05	42.5	0.30	1.09	587.370	144	82	74	0.55	1.56	109.2
1-06	45.0	0.27	0.98	588.805	144	81	74	0.52	1.43	106.0
2-01	47.5	0.40	1.45	590.490	145	75	76	0.63	1.69	102.8
2-02	50.0	0.40	1.45	592.170	145	78	73	0.63	1.68	102.5
2-03	52.5	0.40	1.45	593.850	145	79	73	0.63	1.68	102.4
2-04	55.0	0.39	1.42	595.520	145	80	73	0.62	1.67	103.0
2-05	57.5	0.33	1.12	597.160	145	81	73	0.57	1.64	109.8
2-06	60.0	0.25	0.91	598.545	145	82	73	0.50	1.38	106.4
Final	60.0		1.31671	39.03600	144.33333	76.64583		0.60159	39.03600	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6016	1.3167	39.0360	144.3333	76.6014				

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Field Data Printout

Test Method: **USEPA Method 5/202**
Analyte: **Particulate/CPM**

Location:	FCCU Regenerator Vent			Bar. Press. (in. Hg):	29.96	Nozzle ID No:	275-1
Test Run:	3			Static P:	0.2	Nozzle Diameter (D_n):	0.275
Client:	Marathon			O_2 (dry volume %):	2.30 ☑ Pa ☐ Fail	Probe ID No:	67-6-1
Project No:	12461			CO_2 (dry volume %):	17.50	Pitot C_p:	0.831
Source Area (ft^2):	132.73229			N_2+CO (dry volume %):	80.20	Pitot Leak Check:	
Meter Operator:	M. LeResche	624					
Probe Operator:	A. Christiansen	534					
Test Date:	3/19/14						
Start Time:	09:14			H_2O (condensate, ml or gm):	205.8	Meter Box ID. No:	66-24
Stop Time:	10:23			H_2O (silica, g):	19.3	Meter ΔH@:	1.74760
Leak Rate Before:	0.004	cfm	@ 16 "Hg	Actual Moisture (%):	21.58	Meter Y_d:	0.99310
Leak Rate After:	0.001	cfm	@ 11 "Hg				

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			598.953						
2-01	2.5	0.40	1.45	600.840	144	66	65	0.63	1.89	117.1*
2-02	5.0	0.40	1.45	602.490	144	68	65	0.63	1.65	102.2
2-03	7.5	0.40	1.45	604.020	144	70	65	0.63	1.53	94.6
2-04	10.0	0.38	1.38	605.620	144	69	64	0.62	1.60	101.6
2-05	12.5	0.32	1.16	607.270	144	70	64	0.57	1.65	114.0*
2-06	15.0	0.27	0.98	608.701	143	68	63	0.52	1.43	107.9
1-01	17.5	0.42	1.52	610.380	144	63	61	0.65	1.68	102.4
1-02	20.0	0.43	1.56	612.070	145	65	62	0.66	1.69	101.6
1-03	22.5	0.42	1.52	613.670	145	66	62	0.65	1.60	97.3
1-04	25.0	0.38	1.38	615.210	145	66	62	0.62	1.54	98.4
1-05	27.5	0.32	1.16	616.980	144	66	61	0.57	1.77	123.2*
1-06	30.0	0.32	1.02	618.396	144	67	61	0.57	1.42	98.4
4-01	32.5	0.41	1.49	619.990	145	67	62	0.64	1.59	98.0
4-02	35.0	0.41	1.49	621.650	145	73	63	0.64	1.66	101.3
4-03	37.5	0.41	1.49	623.410	145	75	63	0.64	1.76	107.2
4-04	40.0	0.38	1.38	625.000	145	77	65	0.62	1.59	100.2
4-05	42.5	0.32	1.16	626.570	145	80	65	0.57	1.57	107.5
4-06	45.0	0.26	0.94	627.978	143	82	67	0.51	1.41	106.3
3-01	47.5	0.42	1.52	629.640	145	77	69	0.65	1.66	99.3
3-02	50.0	0.42	1.52	631.320	145	83	70	0.65	1.68	99.7
3-03	52.5	0.42	1.52	633.020	145	84	71	0.65	1.70	100.7
3-04	55.0	0.40	1.45	634.690	145	85	72	0.63	1.67	101.2
3-05	57.5	0.31	1.13	636.250	145	86	73	0.56	1.56	107.1
3-06	60.0	0.26	0.94	637.647	144	85	73	0.51	1.40	104.7
Final	60.0		1.33583	38.69400	144.45833	69.29167		0.60646	38.69400	
24 points sampled		Sq.RLΔP								
QC-Check: Field Averages		0.6049	1.3358	38.6940	144.4583	69.2916				

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USEPA Method 3 Laboratory Data

Test Method: USEPA Method 5/202
Analyte: Particulate/CPM

Location: FCCU Regenerator Stack
Client: Marathon
Project No: 12461
Method: EPA Method 3A
Fuel Type: Select Fuel
F_o for Fuel: N/A

Analyst: S. Lehmann
Analyst Emp No: 514

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
4	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		15.10000		4.30000	80.60000	30.58800	1.09934	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
5	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		16.80000		2.80000	80.40000	30.80000	1.07738	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
6	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		17.90000		1.40000	80.70000	30.92000	1.08939	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis:
	1							
	2							
	3							
	Avg.							
CEM or Other Avg:								☐ Fo value within expected range.

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USEPA Method 4 Laboratory Data

Test Method: USEPA Method 5/202
Location: FCCU Regenerator Stack
Analyte: Particulate/CPM
Client: Marathon
Analyst: S. Lehmann
Project No: 12461
Analyst Emp No: 514

Test Run: 4

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	573.7	402.5	171.2
Impinger 2	Empty	463.2	458.5	4.7
Impinger 3	DI Water	670.9	648.8	22.1
Impinger 4	Silica Gel	741.8	728.7	13.1
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
198.0	Liquid (gm)		
0.0	less rinse (gm)		
198.0	Net Liquid (gm)	198.0	☑ QA/QC OK
+ 13.1	Silica Gel (gm)	13.1	☑ QA/QC OK
211.1	Total Vlc (gm)	211.1	☑ QA/QC OK

Test Run: 5

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	596.8	448.7	148.1
Impinger 2	Empty	447.3	441.3	6.0
Impinger 3	DI Water	574.8	544.8	30.0
Impinger 4	Silica Gel	685.0	666.3	18.7
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
184.1	Liquid (gm)		
0.0	less rinse (gm)		
184.1	Net Liquid (gm)	184.1	☑ QA/QC OK
+ 18.7	Silica Gel (gm)	18.7	☑ QA/QC OK
202.8	Total Vlc (gm)	202.8	☑ QA/QC OK

Test Run: 6

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	598.1	419.3	178.8
Impinger 2	Empty	447.1	445.9	1.2
Impinger 3	*DI Water*	580.1	557.8	22.3
Impinger 4	Silica Gel	722.2	707.5	14.7
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
202.3	Liquid (gm)		
0.0	less rinse (gm)		
202.3	Net Liquid (gm)	202.3	☑ QA/QC OK
+ 14.7	Silica Gel (gm)	14.7	☑ QA/QC OK
217.0	Total Vlc (gm)	217.0	☑ QA/QC OK

Test Run:

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty			
Impinger 2	Empty			
Impinger 3	DI Water			
Impinger 4	Silica Gel			
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
	Liquid (gm)		
	less rinse (gm)		
	Net Liquid (gm)		☐ QA/QC OK
	Silica Gel (gm)		☐ QA/QC OK
	Total Vlc (gm)		☐ QA/QC OK

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Field Data Printout

			Test Method:		USEPA Method 5/202
Location:	FCCU Regenerator Stack		Analyte:		Particulate/CPM
Test Run:	4				
Client:	Marathon		Bar. Press. (in. Hg):	29.95	Nozzle ID No: 275-1
Project No:	12461		Static P:	0.2	Nozzle Diameter (D_n): 0.275
Source Area (ft^2):	132.73229		O_2 (dry volume %):	4.30	Probe ID No: 67-6-1
Meter Operator:	M. LeResche	624	CO_2 (dry volume %):	15.10	Pitot C_p: 0.831
Probe Operator:	A. Christiansen	534	N_2+CO (dry volume %):	80.60	Pitot Leak Check: ☑ Pass ☐ Fail
Test Date:	3/19/14				
Start Time:	11:23				
Stop Time:	12:32		H_2O (condensate, ml or gm):	198.0	Meter Box ID. No: 66-24
Leak Rate Before:	0.000 cfm	@ 15 "Hg	H_2O (silica, g):	13.1	Meter ΔH@: 1.74760
Leak Rate After:	0.001 cfm	@ 11 "Hg	Actual Moisture (%):	20.19	Meter Y_d: 0.99310

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf) 639.323	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
3-01	2.5	0.40	1.45	641.390	145	75	74	0.63	2.07	123.8*
3-02	5.0	0.34	1.23	642.660	146	78	75	0.58	1.27	82.2*
3-03	7.5	0.45	1.63	644.740	146	80	75	0.67	2.08	117.0*
3-04	10.0	1.44	1.60	646.510	146	84	75	1.20	1.77	55.4*
3-05	12.5	0.33	1.20	648.100	146	86	76	0.57	1.59	103.6
3-06	15.0	0.26	0.94	649.525	145	86	76	0.51	1.42	104.5
4-01	17.5	0.40	1.45	651.220	145	81	76	0.63	1.70	100.8
4-02	20.0	0.40	1.45	652.880	145	84	76	0.63	1.66	98.4
4-03	22.5	0.40	1.45	654.540	145	84	76	0.63	1.66	98.4
4-04	25.0	0.37	1.34	656.180	144	84	76	0.61	1.64	101.0
4-05	27.5	0.30	1.09	657.720	144	83	75	0.55	1.54	105.5
4-06	30.0	0.35	1.27	659.279	143	82	75	0.59	1.56	98.9
1-01	32.5	0.40	1.45	661.040	143	77	74	0.63	1.76	105.1
1-02	35.0	0.40	1.45	662.750	144	80	75	0.63	1.71	101.8
1-03	37.5	0.40	1.45	664.440	144	81	75	0.63	1.69	100.5
1-04	40.0	0.40	1.45	666.140	144	83	75	0.63	1.70	100.9
1-05	42.5	0.34	1.23	667.740	144	83	75	0.58	1.60	103.0
1-06	45.0	0.38	1.38	669.343	144	84	75	0.62	1.60	97.5
2-01	47.5	0.40	1.45	671.030	145	80	75	0.63	1.69	100.5
2-02	50.0	0.35	1.27	672.680	145	83	76	0.59	1.65	104.7
2-03	52.5	0.44	1.60	674.410	145	86	76	0.66	1.73	97.7
2-04	55.0	0.44	1.60	676.220	145	87	76	0.66	1.81	102.1
2-05	57.5	0.37	1.34	677.920	145	88	77	0.61	1.70	104.3
2-06	60.0	0.33	1.20	679.530	145	88	78	0.57	1.61	104.5
Final	60.0		1.37375	40.20700	144.70833	79.14583		0.63660	40.20700	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6366	1.3738	40.2070	144.7080	79.1458				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

Location:	FCCU Regenerator Stack	Test Method:	USEPA Method 5/202
Test Run:	5	Analyte:	Particulate/CPM
Client:	Marathon	Bar. Press. (in. Hg):	29.96
Project No:	12461	Static P:	0.2
Source Area (ft^2):	132.73229	O_2 (dry volume %):	2.80
Meter Operator:	M. LeResche 624	CO_2 (dry volume %):	16.80
Probe Operator:	A. Christiansen 534	N_2+CO (dry volume %):	80.40
Test Date:	3/19/14		
Start Time:	13:27		
Stop Time:	14:38	H_2O (condensate, ml or gm):	184.1
Leak Rate Before:	0.002 cfm @ 15 "Hg	H_2O (silica, g):	18.7
Leak Rate After:	0.001 cfm @ 9 "Hg	Actual Moisture (%):	19.86

Nozzle ID No:	275-1	Pitot Leak Check:	☑ Pass ☐ Fail
Nozzle Diameter (D_n):	0.275		
Probe ID No:	67-6-1		
Pitot C_p:	0.831		
Meter Box ID. No:	66-24		
Meter ΔH@:	1.74760		
Meter Y_d:	0.99310		

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s	Sample ΔH	Metered (dcf)	Stack T_s	Dry Gas Meter $T_{m\text{-}in}$	Dry Gas Meter $T_{m\text{-}out}$	$\sqrt{\Delta P_s}$ (calculated)	Volume (calculated)	Isokinetics (calculated)
	0.0	(in. H_2O)	(in. H_2O)	679.835	(°F)	(°F)	(°F)	($\sqrt{in.}$ H_2O)	(ft^3)	(%)
2-01	2.5	0.40	1.45	681.580	144	75	74	0.63	1.75	104.4
2-02	5.0	0.40	1.45	683.260	144	77	75	0.63	1.68	100.3
2-03	7.5	0.39	1.42	684.950	144	81	75	0.62	1.69	101.8
2-04	10.0	0.40	1.45	686.670	145	83	75	0.63	1.72	102.2
2-05	12.5	0.31	1.13	688.220	144	83	75	0.56	1.55	104.4
2-06	15.0	0.31	1.13	689.734	145	84	76	0.56	1.51	101.9
1-01	17.5	0.40	1.45	691.410	145	82	77	0.63	1.68	99.5
1-02	20.0	0.42	1.52	693.150	145	84	77	0.65	1.74	100.6
1-03	22.5	0.42	1.52	694.910	145	86	78	0.65	1.76	101.5
1-04	25.0	0.30	1.09	696.570	144	87	78	0.55	1.66	112.9*
1-05	27.5	0.26	0.94	697.980	144	87	79	0.51	1.41	102.9
1-06	30.0	0.26	0.94	699.340	144	86	78	0.51	1.36	99.4
4-01	32.5	0.42	1.52	701.050	145	84	79	0.65	1.71	98.7
4-02	35.0	0.42	1.52	702.790	145	86	79	0.65	1.74	100.2
4-03	37.5	0.42	1.52	704.540	145	88	80	0.65	1.75	100.5
4-04	40.0	0.42	1.52	706.290	144	90	80	0.65	1.75	100.3
4-05	42.5	0.35	1.27	708.000	144	92	80	0.59	1.71	107.0
4-06	45.0	0.35	1.27	709.603	145	93	81	0.59	1.60	100.3
3-01	47.5	0.41	1.49	711.200	145	85	82	0.64	1.60	92.9
3-02	50.0	0.42	1.52	712.890	145	88	82	0.65	1.69	96.9
3-03	52.5	0.42	1.52	714.650	145	88	82	0.65	1.76	100.9
3-04	55.0	0.39	1.42	716.380	145	88	82	0.62	1.73	102.9
3-05	57.5	0.34	1.23	718.020	145	87	81	0.58	1.64	104.6
3-06	60.0	0.27	0.98	719.485	145	87	82	0.52	1.47	104.7
Final	60.0		1.34458	39.65000	144.62500	82.04167		0.60711	39.65000	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6071	1.3446	39.6500	144.6250	82.0417				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

			Test Method:		**USEPA Method 5/202**
Location:	FCCU Regenerator Stack		**Analyte:**		**Particulate/CPM**
Test Run:	6				
Client:	Marathon		Bar. Press. (in. Hg):	29.96	Nozzle ID No: 275-1
Project No:	12461		Static P:	0.2	Nozzle Diameter (D_n): 0.275
Source Area (ft^2):	132.73229		O_2 (dry volume %):	1.40	Probe ID No: 67-6-1
Meter Operator:	M. LeResche	624	CO_2 (dry volume %):	17.90	Pitot C_p: 0.831
Probe Operator:	A. Christiansen	534	N_2+CO (dry volume %):	80.70	Pitot Leak Check: ☑ Pass ☐ Fail
Test Date:	3/19/14				
Start Time:	15:31				
Stop Time:	16:41		H_2O (condensate, ml or gm):	202.3	Meter Box ID. No: 66-24
Leak Rate Before:	0.002 cfm	@ 16 "Hg	H_2O (silica, g):	14.7	Meter ΔH@: 1.74760
Leak Rate After:	0.001 cfm	@ 10 "Hg	Actual Moisture (%):	21.42	Meter Y_d: 0.99310

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			719.655						
3-01	2.5	0.40	1.45	721.380	144	83	82	0.63	1.73	103.5
3-02	5.0	0.40	1.45	723.100	144	87	83	0.63	1.72	102.8
3-03	7.5	0.40	1.45	724.790	145	90	84	0.63	1.69	100.7
3-04	10.0	0.40	1.45	726.500	144	92	84	0.63	1.71	101.6
3-05	12.5	0.33	1.20	728.110	144	91	85	0.57	1.61	105.3
3-06	15.0	0.33	1.20	729.651	144	91	85	0.57	1.54	100.8
4-01	17.5	0.38	1.38	731.280	144	88	86	0.62	1.63	99.5
4-02	20.0	0.40	1.45	732.980	144	90	86	0.63	1.70	101.0
4-03	22.5	0.38	1.35	734.670	144	89	85	0.62	1.69	103.2
4-04	25.0	0.35	1.27	736.290	144	90	85	0.59	1.62	103.0
4-05	27.5	0.25	0.91	737.690	144	91	85	0.50	1.40	105.1
4-06	30.0	0.25	0.91	739.036	144	90	85	0.50	1.35	101.1
1-01	32.5	0.38	1.38	740.700	144	87	85	0.62	1.66	101.8
1-02	35.0	0.40	1.45	742.400	145	89	85	0.63	1.70	101.3
1-03	37.5	0.42	1.52	744.140	145	90	85	0.65	1.74	101.1
1-04	40.0	0.36	1.30	745.790	145	89	85	0.60	1.65	103.6
1-05	42.5	0.30	1.09	747.320	144	89	87	0.55	1.53	104.9
1-06	45.0	0.27	0.98	748.746	144	89	84	0.52	1.43	103.3
2-01	47.5	0.38	1.38	750.330	144	85	84	0.62	1.58	97.2
2-02	50.0	0.40	1.45	752.030	145	89	84	0.63	1.70	101.4
2-03	52.5	0.40	1.45	753.780	144	90	84	0.63	1.75	104.2
2-04	55.0	0.36	1.30	755.440	144	92	84	0.60	1.66	103.9
2-05	57.5	0.36	1.30	757.050	144	91	84	0.60	1.61	100.9
2-06	60.0	0.30	1.09	758.568	144	91	84	0.55	1.52	104.2
Final	60.0		1.29833	38.91300	144.20833	86.93750		0.59704	38.91300	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.5970	1.2983	38.9130	144.2083	86.9375				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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USEPA Method 3 Laboratory Data

Test Method: USEPA Method 8

Location: FCCU Regenerator Vent
Analyte: H2SO4

Client: Marathon

Project No: 12461

Method: EPA Method 3A

Fuel Type: Select Fuel

F_o for Fuel: N/A

Analyst: S. Lehmann

Analyst Emp No: 514

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
1	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		17.10000		2.80000	80.10000	30.84800	1.05848	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
2	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		17.80000		1.90000	80.30000	30.92400	1.06742	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
3	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		18.00000		1.70000	80.30000	30.94800	1.06667	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis:
	1							
	2							
	3							
	Avg.							
CEM or Other Avg:								☐ Fo value within expected range.

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USEPA Method 4 Laboratory Data

Location: FCCU Regenerator Vent
Client: Marathon
Project No: 12461

Test Method: USEPA Method 8
Analyte: H2SO4
Analyst: C. Murdock
Analyst Emp No: 628

Test Run: 1

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	80%Isopropanol	635.5	540.7	94.8
Impinger 2	DI Water	594.2	541.0	53.2
Impinger 3	DI Water	575.2	542.6	32.6
Impinger 4	Silica Gel	696.9	666.1	30.8
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
180.6	Liquid (gm)		
0.0	less rinse (gm)		
180.6	Net Liquid (gm)	180.6	☑ QA/QC OK
+ 30.8	Silica Gel (gm)	30.8	☑ QA/QC OK
211.4	Total Vlc (gm)	211.4	☑ QA/QC OK

Test Run: 2

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	80%Isopropanol	607.2	515.0	92.2
Impinger 2	DI Water	616.3	562.2	54.1
Impinger 3	DI Water	685.9	649.6	36.3
Impinger 4	Silica Gel	816.8	777.1	39.7
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
182.6	Liquid (gm)		
0.0	less rinse (gm)		
182.6	Net Liquid (gm)	182.6	☑ QA/QC OK
+ 39.7	Silica Gel (gm)	39.7	☑ QA/QC OK
222.3	Total Vlc (gm)	222.3	☑ QA/QC OK

Test Run: 3

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	80%Isopropanol	633.3	550.4	82.9
Impinger 2	DI Water	599.6	535.5	64.1
Impinger 3	DI Water	579.0	544.6	34.4
Impinger 4	Silica Gel	717.8	696.7	21.1
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
181.4	Liquid (gm)		
0.0	less rinse (gm)		
181.4	Net Liquid (gm)	181.4	☑ QA/QC OK
+ 21.1	Silica Gel (gm)	21.1	☑ QA/QC OK
202.5	Total Vlc (gm)	202.5	☑ QA/QC OK

Test Run:

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	80%Isopropanol			
Impinger 2	DI Water			
Impinger 3	DI Water			
Impinger 4	Silica Gel			
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
	Liquid (gm)		
	less rinse (gm)		
	Net Liquid (gm)		☐ QA/QC OK
	Silica Gel (gm)		☐ QA/QC OK
	Total Vlc (gm)		☐ QA/QC OK

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Field Data Printout

Location:	FCCU Regenerator Vent		Test Method:	USEPA Method 8	
Test Run:	1		Analyte:	H2SO4	
Client:	Marathon		Bar. Press. (in. Hg):	29.96	Nozzle ID No: 275-1
Project No:	12461		Static P:	0.2	Nozzle Diameter (D_n): 0.275
Source Area (ft^2):	132.73229		O_2 (dry volume %):	2.80	Probe ID No: 67-6-1
Meter Operator:	M. LeResche	624	CO_2 (dry volume %):	17.10	Pitot C_p: 0.831
Probe Operator:	A. Christiansen	534	N_2+CO (dry volume %):	80.10	Pitot Leak Check: ☑ Pass ☐ Fail
Test Date:	3/20/14				
Start Time:	09:31				
Stop Time:	10:50		H_2O (condensate, ml or gm):	180.6	Meter Box ID. No: 66-24
Leak Rate Before:	0.002 cfm	@ 15 "Hg	H_2O (silica, g):	30.8	Meter ΔH@: 1.74760
Leak Rate After:	0.002 cfm	@ 12 "Hg	Actual Moisture (%):	20.93	Meter Y_d: 0.99310

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			758.786						
2-01	2.5	0.40	1.45	760.560	144	70	69	0.63	1.77	108.4
2-02	5.0	0.40	1.45	762.110	144	72	69	0.63	1.55	94.6
2-03	7.5	0.38	1.38	763.740	144	74	69	0.62	1.63	101.8
2-04	10.0	0.32	1.16	765.310	143	74	69	0.57	1.57	106.7
2-05	12.5	0.27	0.98	766.770	143	75	69	0.52	1.46	107.9
2-06	15.0	0.25	0.91	768.115	143	75	69	0.50	1.35	103.3
1-01	17.5	0.40	1.45	769.630	143	70	68	0.63	1.51	92.6
1-02	20.0	0.40	1.45	771.280	144	75	69	0.63	1.65	100.4
1-03	22.5	0.38	1.38	772.930	144	75	69	0.62	1.65	103.0
1-04	25.0	0.38	1.38	774.530	143	77	69	0.62	1.60	99.6
1-05	27.5	0.27	0.98	775.990	144	78	70	0.52	1.46	107.6
1-06	30.0	0.27	0.98	777.497	144	79	70	0.52	1.51	110.9*
4-01	32.5	0.40	1.45	779.060	145	77	70	0.63	1.56	94.9
4-02	35.0	0.40	1.45	780.760	144	79	71	0.63	1.70	102.8
4-03	37.5	0.40	1.45	782.440	145	79	71	0.63	1.68	101.7
4-04	40.0	0.37	1.34	784.100	145	79	71	0.61	1.66	104.5
4-05	42.5	0.27	0.98	785.530	145	80	73	0.52	1.43	105.0
4-06	45.0	0.24	0.87	786.851	144	80	71	0.49	1.32	102.9
3-01	47.5	0.40	1.45	788.450	145	75	72	0.63	1.60	97.1
3-02	50.0	0.49	1.78	790.190	145	79	73	0.70	1.74	95.1
3-03	52.5	0.40	1.45	791.910	145	76	72	0.63	1.72	104.3
3-04	55.0	0.40	1.45	793.590	145	78	72	0.63	1.68	101.7
3-05	57.5	0.38	1.38	795.240	145	79	73	0.62	1.65	102.3
3-06	60.0	0.38	1.38	796.868	144	79	73	0.62	1.63	100.8
Final	60.0		1.30750	38.08200	144.16667	73.43750		0.59788	38.08200	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.5979	1.3075	38.0820	144.1667	73.4375				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

				Test Method:	**USEPA Method 8**
Location:	FCCU Regenerator Vent			**Analyte:**	**H2SO4**
Test Run:	2				
Client:	Marathon		Bar. Press. (in. Hg):	29.96	Nozzle ID No: 275-1
Project No:	12461		Static P:	0.2	Nozzle Diameter (D_n): 0.275
Source Area (ft^2):	132.73229		O_2 (dry volume %):	1.90	Probe ID No: 67-6-1
Meter Operator:	M. LeResche	624	CO_2 (dry volume %):	17.80	Pitot C_p: 0.831
Probe Operator:	A. Christiansen	534	N_2+CO (dry volume %):	80.30	Pitot Leak Check: ☑ Pass ☐ Fail
Test Date:	3/20/14				
Start Time:	11:55				
Stop Time:	13:02		H_2O (condensate, ml or gm):	182.6	Meter Box ID. No: 66-24
Leak Rate Before:	0.001 cfm	@ 15 "Hg	H_2O (silica, g):	39.7	Meter ΔH@: 1.74760
Leak Rate After:	0.002 cfm	@ 16 "Hg	Actual Moisture (%):	21.27	Meter Y_d: 0.99310

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s	Sample ΔH	Metered (dcf)	Stack T_s	Dry Gas Meter $T_{m\text{-}in}$	Dry Gas Meter $T_{m\text{-}out}$	$\sqrt{\Delta P_s}$ (calculated)	Volume (calculated)	Isokinetics (calculated)
	0.0	(in. H_2O)	(in. H_2O)	797.125	(°F)	(°F)	(°F)	($\sqrt{}$in. H_2O)	(ft^3)	(%)
3-01	2.5	0.38	1.38	798.770	143	68	68	0.62	1.64	103.8
3-02	5.0	0.40	1.45	800.420	144	68	68	0.63	1.65	101.6
3-03	7.5	0.40	1.45	802.420	144	69	68	0.63	2.00	123.0*
3-04	10.0	0.30	1.09	803.560	144	71	68	0.55	1.14	80.8*
3-05	12.5	0.32	1.16	805.050	144	73	68	0.57	1.49	102.0
3-06	15.0	0.25	0.91	806.491	144	75	68	0.50	1.44	111.4*
4-01	17.5	0.38	1.38	808.080	144	75	69	0.62	1.59	99.6
4-02	20.0	0.40	1.45	809.780	144	77	70	0.63	1.70	103.6
4-03	22.5	0.42	1.52	811.470	144	78	70	0.65	1.69	100.4
4-04	25.0	0.40	1.45	813.100	144	79	70	0.63	1.63	99.2
4-05	27.5	0.40	1.45	814.760	144	80	70	0.63	1.66	100.9
4-06	30.0	0.42	1.52	816.426	144	80	71	0.65	1.67	98.7
1-01	32.5	0.38	1.38	818.070	144	78	71	0.62	1.64	102.6
1-02	35.0	0.40	1.45	819.860	143	79	72	0.63	1.79	108.6
1-03	37.5	0.42	1.52	821.660	144	80	72	0.65	1.80	106.6
1-04	40.0	0.40	1.45	823.400	143	80	72	0.63	1.74	105.5
1-05	42.5	0.38	1.38	825.120	143	80	72	0.62	1.72	106.9
1-06	45.0	0.32	1.16	826.791	143	81	72	0.57	1.67	113.0*
2-01	47.5	0.38	1.38	828.280	144	79	72	0.62	1.49	92.7
2-02	50.0	0.38	1.38	829.920	144	80	72	0.62	1.64	102.0
2-03	52.5	0.38	1.38	831.620	143	82	73	0.62	1.70	105.4
2-04	55.0	0.40	1.45	833.280	144	84	73	0.63	1.66	100.2
2-05	57.5	0.32	1.16	834.850	144	84	74	0.57	1.57	105.8
2-06	60.0	0.32	1.16	836.410	144	84	74	0.57	1.56	105.1
Final	60.0		1.35250	39.28500	143.75000	74.18750		0.60956	39.28500	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6096	1.3525	39.2850	143.7500	74.1875				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

			Test Method:		USEPA Method 8
Location:	FCCU Regenerator Vent		Analyte:		H2SO4
Test Run:	3				
Client:	Marathon		Bar. Press. (in. Hg):	29.96	Nozzle ID No: 275-1
Project No:	12461		Static P:	0.2	Nozzle Diameter (D_n): 0.275
Source Area (ft^2):	132.73229		O_2 (dry volume %):	1.70	Probe ID No: 67-6-1
Meter Operator:	M. LeResche	624	CO_2 (dry volume %):	18.00	Pitot C_p: 0.831
Probe Operator:	A. Christiansen	534	N_2+CO (dry volume %):	80.30	Pitot Leak Check: ☑ Pass ☐ Fail
Test Date:	3/20/14				
Start Time:	13:26				
Stop Time:	14:32		H_2O (condensate, ml or gm):	181.4	Meter Box ID. No: 66-24
Leak Rate Before:	0.001 cfm	@ 15 "Hg	H_2O (silica, g):	21.1	Meter ΔH@: 1.74760
Leak Rate After:	0.000 cfm	@ 17 "Hg	Actual Moisture (%):	20.37	Meter Y_d: 0.99310

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			837.518						
2-01	2.5	0.38	1.38	839.070	144	76	74	0.62	1.55	95.9
2-02	5.0	0.40	1.45	840.770	144	78	74	0.63	1.70	102.2
2-03	7.5	0.40	1.45	842.440	144	79	74	0.63	1.67	100.3
2-04	10.0	0.38	1.38	843.780	145	79	74	0.62	1.34	82.6*
2-05	12.5	0.30	1.09	845.640	144	80	73	0.55	1.86	128.9*
2-06	15.0	0.27	0.98	847.042	144	80	73	0.52	1.40	102.4
1-01	17.5	0.40	1.45	848.540	144	80	74	0.63	1.50	89.9*
1-02	20.0	0.40	1.45	850.190	144	82	74	0.63	1.65	98.8
1-03	22.5	0.40	1.45	851.810	144	84	75	0.63	1.62	96.8
1-04	25.0	0.38	1.38	853.380	144	86	75	0.62	1.57	96.0
1-05	27.5	0.30	1.09	854.820	144	86	76	0.55	1.44	99.0
1-06	30.0	0.25	0.91	856.137	144	87	76	0.50	1.32	99.0
4-01	32.5	0.38	1.38	857.800	144	86	77	0.62	1.66	101.5
4-02	35.0	0.40	1.45	859.530	145	88	78	0.63	1.73	102.7
4-03	37.5	0.40	1.45	861.290	144	89	78	0.63	1.76	104.3
4-04	40.0	0.36	1.31	863.060	145	89	80	0.60	1.77	110.5*
4-05	42.5	0.29	1.05	864.620	144	86	78	0.54	1.56	108.8
4-06	45.0	0.25	0.91	865.823	144	84	78	0.50	1.20	90.5
3-01	47.5	0.38	1.38	867.430	144	82	77	0.62	1.61	98.5
3-02	50.0	0.42	1.52	869.180	144	83	77	0.65	1.75	101.9
3-03	52.5	0.40	1.45	870.870	144	84	77	0.63	1.69	100.8
3-04	55.0	0.40	1.45	872.540	144	84	77	0.63	1.67	99.6
3-05	57.5	0.32	1.16	874.120	145	85	77	0.57	1.58	105.2
3-06	60.0	0.32	1.16	875.698	144	85	77	0.57	1.58	105.0
Final	60.0		1.29708	38.18000	144.16667	79.68750		0.59614	38.18000	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.5962	1.2971	38.1800	144.1667	79.6875				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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USEPA Method 3 Laboratory Data

Test Method: USEPA Method 8
Analyte: H2SO4

Location: FCCU Regenerator Vent
Client: Marathon
Project No: 12461
Method: EPA Method 3A
Fuel Type: Select Fuel
F_o for Fuel: N/A

Analyst: S. Lehmann
Analyst Emp No: 514

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
4	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		17.50000		2.00000	80.50000	30.88000	1.08000	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
5	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		17.70000		2.10000	80.20000	30.91600	1.06215	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
6	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		18.00000		1.60000	80.40000	30.94400	1.07222	☐ Fo value within expected range.

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis:
	1							
	2							
	3							
	Avg.							
CEM or Other Avg:								☐ Fo value within expected range.

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USEPA Method 4 Laboratory Data

Location: FCCU Regenerator Vent
Client: Marathon
Project No: 12461

Test Method: USEPA Method 8
Analyte: H2SO4
Analyst: C. Murdock
Analyst Emp No: 628

Test Run: 4

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	80%Isopropanol	602.4	516.8	85.6
Impinger 2	DI Water	624.6	562.6	62.0
Impinger 3	DI Water	690.6	651.3	39.3
Impinger 4	Silica Gel	845.6	816.6	29.0
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
186.9	Liquid (gm)		
0.0	less rinse (gm)		
186.9	Net Liquid (gm)	186.9	☑ QA/QC OK
+ 29.0	Silica Gel (gm)	29.0	☑ QA/QC OK
215.9	Total Vlc (gm)	215.9	☑ QA/QC OK

Test Run: 5

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	80%Isopropanol	667.2	548.6	118.6
Impinger 2	DI Water	597.0	536.1	60.9
Impinger 3	DI Water	574.1	544.5	29.6
Impinger 4	Silica Gel	767.2	735.8	31.4
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
209.1	Liquid (gm)		
0.0	less rinse (gm)		
209.1	Net Liquid (gm)	209.1	☑ QA/QC OK
+ 31.4	Silica Gel (gm)	31.4	☑ QA/QC OK
240.5	Total Vlc (gm)	240.5	☑ QA/QC OK

Test Run: 6

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	80%Isopropanol	605.7	553.9	51.8
Impinger 2	DI Water	648.7	563.7	85.0
Impinger 3	DI Water	687.3	653.0	34.3
Impinger 4	Silica Gel	860.0	845.0	15.0
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
171.1	Liquid (gm)		
0.0	less rinse (gm)		
171.1	Net Liquid (gm)	171.1	☑ QA/QC OK
+ 15.0	Silica Gel (gm)	15.0	☑ QA/QC OK
186.1	Total Vlc (gm)	186.1	☑ QA/QC OK

Test Run:

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	80%Isopropanol			
Impinger 2	DI Water			
Impinger 3	DI Water			
Impinger 4	Silica Gel			
Impinger 5				
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
	Liquid (gm)		
	less rinse (gm)		
	Net Liquid (gm)		☐ QA/QC OK
	Silica Gel (gm)		☐ QA/QC OK
	Total Vlc (gm)		☐ QA/QC OK

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Field Data Printout

Location:	FCCU Regenerator Vent		Test Method:	USEPA Method 8	
Test Run:	4		Analyte:	H2SO4	
Client:	Marathon		Bar. Press. (in. Hg):	29.91	Nozzle ID No: 275-1
Project No:	12461		Static P:	0.2	Nozzle Diameter (D_n): 0.275
Source Area (ft^2):	132.73229		O_2 (dry volume %):	2.00	Probe ID No: 67-6-1
Meter Operator:	M. LeResche	624	CO_2 (dry volume %):	17.50	Pitot C_p: 0.831
Probe Operator:	A. Christiansen	534	N_2+CO (dry volume %):	80.50	Pitot Leak Check: ☑ Pass ☐ Fail
Test Date:	3/21/14				
Start Time:	08:23				
Stop Time:	09:32		H_2O (condensate, ml or gm):	186.9	Meter Box ID. No: 66-24
Leak Rate Before:	0.001 cfm	@ 17 "Hg	H_2O (silica, g):	29.0	Meter ΔH@: 1.74760
Leak Rate After:	0.001 cfm	@ 18 "Hg	Actual Moisture (%):	20.85	Meter Y_d: 0.99310

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			875.943						
3-01	2.5	0.42	1.52	877.670	145	71	69	0.65	1.73	102.9
3-02	5.0	0.42	1.52	879.410	145	74	70	0.65	1.74	103.3
3-03	7.5	0.43	1.56	881.200	145	78	71	0.66	1.79	104.5
3-04	10.0	0.40	1.45	882.900	145	82	71	0.63	1.70	102.5
3-05	12.5	0.33	1.20	884.450	145	84	72	0.57	1.55	102.6
3-06	15.0	0.27	0.98	885.881	145	84	73	0.52	1.43	104.5
4-01	17.5	0.40	1.45	887.530	145	84	74	0.63	1.65	99.0
4-02	20.0	0.42	1.52	889.260	145	84	74	0.65	1.73	101.4
4-03	22.5	0.42	1.52	890.980	144	87	75	0.65	1.72	100.3
4-04	25.0	0.37	1.35	892.660	144	88	75	0.61	1.68	104.2
4-05	27.5	0.32	1.16	894.230	144	89	76	0.57	1.57	104.5
4-06	30.0	0.27	0.98	895.682	144	88	77	0.52	1.45	105.2
1-01	32.5	0.42	1.52	897.050	144	82	78	0.65	1.37	79.9*
1-02	35.0	0.42	1.52	898.860	144	88	79	0.65	1.81	105.1
1-03	37.5	0.42	1.52	900.680	144	91	79	0.65	1.82	105.4
1-04	40.0	0.38	1.38	902.380	144	92	80	0.62	1.70	103.2
1-05	42.5	0.32	1.16	904.000	144	93	81	0.57	1.62	107.0
1-06	45.0	0.32	1.16	905.500	144	93	81	0.57	1.50	99.0
2-01	47.5	0.42	1.52	906.130	144	90	82	0.65	0.63	36.4*
2-02	50.0	0.42	1.52	908.510	144	92	83	0.65	2.38	137.2*
2-03	52.5	0.42	1.52	910.730	144	93	84	0.65	2.22	127.7*
2-04	55.0	0.37	1.35	912.410	144	94	84	0.61	1.68	102.8
2-05	57.5	0.37	1.35	914.080	144	94	84	0.61	1.67	102.2
2-06	60.0	0.36	1.31	915.726	144	95	85	0.60	1.65	101.9
Final	60.0		1.37667	39.78300	144.33333	82.22917		0.61473	39.78300	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6148	1.3767	39.7830	144.3333	82.2292				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

Test Method: USEPA Method 8

Location: FCCU Regenerator Vent — Analyte: H2SO4

Test Run: 5

Client: Marathon — Bar. Press. (in. Hg): 29.91 — Nozzle ID No: 275-1

Project No: 12461 — Static P: 0.2 — Nozzle Diameter (D_n): 0.275

Source Area (ft^2): 132.73229 — O_2 (dry volume %): 2.10 — Probe ID No: 67-6-1

Meter Operator: M. LeResche 624 — CO_2 (dry volume %): 17.70 — Pitot C_p: 0.831

Probe Operator: A. Christiansen 534 — N_2+CO (dry volume %): 80.20 — Pitot Leak Check: ☑ Pass ☐ Fail

Test Date: 3/21/14

Start Time: 10:06

Stop Time: 11:11 — H_2O (condensate, ml or gm): 209.1 — Meter Box ID. No: 66-24

Leak Rate Before: 0.001 cfm @ 15 "Hg — H_2O (silica, g): 31.4 — Meter ΔH@: 1.74760

Leak Rate After: 0.008 cfm @ 17 "Hg — Actual Moisture (%): 21.87 — Meter Y_d: 0.99310

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			915.130						
2-01	2.5	0.40	1.45	917.870	144	79	82	0.63	2.74	165.7*
2-02	5.0	0.41	1.49	919.590	144	81	81	0.64	1.72	102.7
2-03	7.5	0.40	1.45	921.300	144	82	81	0.63	1.71	103.2
2-04	10.0	0.40	1.45	923.040	144	86	80	0.63	1.74	104.7
2-05	12.5	0.37	1.35	924.770	144	88	81	0.61	1.73	108.0
2-06	15.0	0.30	1.09	926.286	144	87	80	0.55	1.52	105.2
1-01	17.5	0.40	1.45	927.990	144	85	79	0.63	1.70	102.8
1-02	20.0	0.42	1.52	929.700	144	88	80	0.65	1.71	100.3
1-03	22.5	0.42	1.52	931.440	144	87	79	0.65	1.74	102.2
1-04	25.0	0.43	1.56	933.200	143	87	79	0.66	1.76	102.1
1-05	27.5	0.38	1.38	934.880	144	88	79	0.62	1.68	103.6
1-06	30.0	0.38	1.38	936.502	144	90	79	0.62	1.62	99.9
4-01	32.5	0.38	1.38	938.120	144	88	80	0.62	1.62	99.7
4-02	35.0	0.43	1.56	939.850	144	91	81	0.66	1.73	99.9
4-03	37.5	0.42	1.52	941.560	144	93	82	0.65	1.71	99.6
4-04	40.0	0.25	0.91	943.140	144	94	82	0.50	1.58	119.0*
4-05	42.5	0.25	0.91	944.540	144	94	83	0.50	1.40	105.4
4-06	45.0	0.25	0.91	945.911	144	95	84	0.50	1.37	103.0
3-01	47.5	0.38	1.38	947.600	144	94	84	0.62	1.69	103.2
3-02	50.0	0.41	1.49	949.350	145	96	85	0.64	1.75	102.7
3-03	52.5	0.40	1.45	951.100	145	96	85	0.63	1.75	104.0
3-04	55.0	0.33	1.20	952.700	145	95	86	0.57	1.60	104.6
3-05	57.5	0.32	1.16	954.280	145	96	86	0.57	1.58	104.8
3-06	60.0	0.30	1.09	955.860	145	95	86	0.55	1.58	108.3
Final	60.0		1.33542	40.73000	144.16667	85.81250		0.60451	40.73000	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6045	1.3354	42.7300	144.1667	85.8125				
		☑ Avg. OK	☑ Avg. OK	☐ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

Location:	FCCU Regenerator Vent		Test Method:	USEPA Method 8	
Test Run:	6		Analyte:	H2SO4	
Client:	Marathon		Bar. Press. (in. Hg):	29.91	Nozzle ID No: 275-1
Project No:	12461		Static P:	0.2	Nozzle Diameter (D_n): 0.275
Source Area (ft^2):	132.73229		O_2 (dry volume %):	1.60	Probe ID No: 67-6-1
Meter Operator:	M. LeResche	624	CO_2 (dry volume %):	18.00	Pitot C_p: 0.831
Probe Operator:	A. Christiansen	534	N_2+CO (dry volume %):	80.40	Pitot Leak Check: ☑ Pass ☐ Fail
Test Date:	3/21/14				
Start Time:	11:42				
Stop Time:	12:48		H_2O (condensate, ml or gm):	171.1	Meter Box ID. No: 66-24
Leak Rate Before:	0.001 cfm	@ 15 "Hg	H_2O (silica, g):	15.0	Meter ΔH@: 1.74760
Leak Rate After:	0.002 cfm	@ 15 "Hg	Actual Moisture (%):	18.82	Meter Y_d: 0.99310

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			956.760						
3-01	2.5	0.40	1.45	958.520	145	85	85	0.63	1.76	102.4
3-02	5.0	0.40	1.45	960.250	145	87	85	0.63	1.73	100.5
3-03	7.5	0.40	1.45	962.010	145	88	84	0.63	1.76	102.2
3-04	10.0	0.40	1.45	963.780	145	88	84	0.63	1.77	102.8
3-05	12.5	0.33	1.20	965.440	144	89	83	0.57	1.66	106.0
3-06	15.0	0.33	1.20	967.031	145	90	84	0.57	1.59	101.5
4-01	17.5	0.40	1.45	968.640	144	86	82	0.63	1.61	93.7
4-02	20.0	0.40	1.45	970.310	145	87	83	0.63	1.67	97.2
4-03	22.5	0.40	1.45	972.020	144	88	82	0.63	1.71	99.4
4-04	25.0	0.37	1.35	973.650	144	88	82	0.61	1.63	98.5
4-05	27.5	0.30	1.09	975.140	144	87	82	0.55	1.49	100.1
4-06	30.0	0.30	1.09	976.580	144	88	82	0.55	1.44	96.6
1-01	32.5	0.40	1.45	978.200	145	85	82	0.63	1.62	94.5
1-02	35.0	0.42	1.52	979.980	144	87	81	0.65	1.78	101.2
1-03	37.5	0.43	1.56	981.780	144	87	81	0.66	1.80	101.2
1-04	40.0	0.27	0.98	983.300	143	86	81	0.52	1.52	107.7
1-05	42.5	0.27	0.98	984.730	144	87	81	0.52	1.43	101.3
1-06	45.0	0.27	0.98	986.105	144	87	81	0.52	1.38	97.4
2-01	47.5	0.40	1.45	987.750	144	86	81	0.63	1.64	95.9
2-02	50.0	0.40	1.45	989.460	144	87	81	0.63	1.71	99.6
2-03	52.5	0.40	1.45	991.150	144	88	81	0.63	1.69	98.4
2-04	55.0	0.37	1.35	992.700	144	88	81	0.61	1.55	93.8
2-05	57.5	0.37	1.35	994.270	144	89	81	0.61	1.57	94.9
2-06	60.0	0.30	1.09	995.900	144	89	81	0.55	1.63	109.4
Final	60.0		1.32042	39.14000	144.25000	84.75000		0.60152	39.14000	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6016	1.3204	39.1400	144.2500	84.7500				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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USEPA Method 3 Laboratory Data

Test Method: USEPA OTM 029
Analyte: Hydrogen Cyanide

Location: FCCU Regenerator Vent
Client: Marathon
Project No: 12461
Method: EPA Method 3A
Fuel Type: Select Fuel
F_o for Fuel: N/A

Analyst: S. Lehmann
Analyst Emp No: 514

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
1	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		13.50000		2.70000	83.80000	30.26800	1.34815	☐ Fo value within expected range.

Run Number	Trial	Percent CO2	Percent O2+CO2	Percent O2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
2	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		13.80000		2.90000	83.30000	30.32400	1.30435	☐ Fo value within expected range.

Run Number	Trial	Percent CO2	Percent O2+CO2	Percent O2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
3	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		11.70000		3.70000	84.60000	30.02000	1.47009	☐ Fo value within expected range.

Run Number	Trial	Percent CO2	Percent O2+CO2	Percent O2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
8	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		13.40000		2.30000	84.30000	30.23600	1.38806	☐ Fo value within expected range.

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USEPA Method 4 Laboratory Data

Location: FCCU Regenerator Vent
Client: Marathon
Project No: 12461

Test Method: USEPA OTM 029
Analyte: Hydrogen Cyanide
Analyst: C. Murdock
Analyst Emp No: 628

Test Run: 1

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	814.8	666.7	148.1
Impinger 2	200 ml 6N NaOH	724.1	655.1	69.0
Impinger 3	200 ml 6N NaOH	671.3	645.4	25.9
Impinger 4	200 ml 6N NaOH	544.6	531.8	12.8
Impinger 5	100 ml 6N NaOH	666.5	657.5	9.0
Impinger 6	Silica Gel			
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
255.8	Liquid (gm)		
0.0	less rinse (gm)		
255.8	Net Liquid (gm)	255.8	☑ QA/QC OK
+ 9.0	Silica Gel (gm)	9.0	☑ QA/QC OK
264.8	Total Vlc (gm)	264.8	☑ QA/QC OK

Test Run: 2

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	858.1	658.4	199.7
Impinger 2	200 ml 6N NaOH	591.9	549.6	42.3
Impinger 3	200 ml 6N NaOH	658.5	626.5	32.0
Impinger 4	200 ml 6N NaOH	671.4	644.8	26.6
Impinger 5	100 ml 6N NaOH	671.8	644.8	27.0
Impinger 6	Silica Gel	754.6	749.0	5.6
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
327.6	Liquid (gm)		
0.0	less rinse (gm)		
327.6	Net Liquid (gm)	327.6	☑ QA/QC OK
+ 5.6	Silica Gel (gm)	5.6	☑ QA/QC OK
333.2	Total Vlc (gm)	333.2	☑ QA/QC OK

Test Run: 3

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	805.5	653.5	152.0
Impinger 2	200 ml 6N NaOH	691.6	647.6	44.0
Impinger 3	200 ml 6N NaOH	645.9	622.8	23.1
Impinger 4	200 ml 6N NaOH	651.7	633.3	18.4
Impinger 5	100 ml 6N NaOH	551.5	542.6	8.9
Impinger 6	Silica Gel	757.6	752.8	4.8
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
246.4	Liquid (gm)		
0.0	less rinse (gm)		
246.4	Net Liquid (gm)	246.4	☑ QA/QC OK
+ 4.8	Silica Gel (gm)	4.8	☑ QA/QC OK
251.2	Total Vlc (gm)	251.2	☑ QA/QC OK

Test Run: 8

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1		780.8	646.7	134.1
Impinger 2		717.3	648.5	68.8
Impinger 3		654.4	624.7	29.7
Impinger 4		658.5	637.7	20.8
Impinger 5		546.2	535.6	10.6
Impinger 6				
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
253.4	Liquid (gm)		
0.0	less rinse (gm)		
253.4	Net Liquid (gm)	253.4	☑ QA/QC OK
+ 10.6	Silica Gel (gm)	10.6	☑ QA/QC OK
264.0	Total Vlc (gm)	264.0	☑ QA/QC OK

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Field Data Printout

Test Method: USEPA OTM 029
Analyte: Hydrogen Cyanide

Location: FCCU Regenerator Vent
Test Run: 1
Client: Marathon
Project No: 12461
Source Area (ft^2): 132.73229
Meter Operator: J. Lopez 330
Probe Operator: A. Christiansen 534
Test Date: 3/18/14
Start Time: 10:45
Stop Time: 12:01
Leak Rate Before: 0.003 cfm @ 15 "Hg
Leak Rate After: 0.002 cfm @ 10 "Hg

Bar. Press. (in. Hg): 29.76
Static P: 0.2
O_2 (dry volume %): 2.70
CO_2 (dry volume %): 17.45
N_2+CO (dry volume %): 79.85

Nozzle ID No: 250-1
Nozzle Diameter (D_n): 0.250
Probe ID No: 67M5-6-10
Pitot C_p: 0.8320
Pitot Leak Check: ☑ Pass ☐ Fail

Meter Box ID. No: 66-21
Meter ΔH@: 1.75370
Meter Y_d: 0.98840

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s	Sample ΔH	Metered (dcf)	Stack T_s	Dry Gas Meter $T_{m\text{-}in}$	Dry Gas Meter $T_{m\text{-}out}$	$\sqrt{\Delta P_s}$ (calculated)	Volume (calculated)	Isokinetics (calculated)
	0.0	(in. H_2O)	(in. H_2O)	143.080	(°F)	(°F)	(°F)	($\sqrt{in.\ H_2O}$)	(ft^3)	(%)
3-01	2.5	0.39	0.97	144.410	143	61	60	0.62	1.33	101.4
3-02	5.0	0.41	1.00	145.830	143	61	60	0.64	1.42	105.6
3-03	7.5	0.41	1.00	147.270	143	62	60	0.64	1.44	107.0
3-04	10.0	0.41	1.00	148.370	143	64	60	0.64	1.10	81.5*
3-05	12.5	0.35	0.87	150.020	143	66	60	0.59	1.65	132.1*
3-06	15.0	0.35	0.87	151.485	143	67	61	0.59	1.47	117.1*
2-01	17.5	0.39	0.97	152.820	143	66	62	0.62	1.33	101.1
2-02	20.0	0.38	0.91	154.180	143	69	63	0.62	1.36	103.9
2-03	22.5	0.38	0.91	155.460	143	69	63	0.62	1.28	97.8
2-04	25.0	0.37	0.92	156.920	143	70	63	0.61	1.46	112.9*
2-05	27.5	0.33	0.82	158.280	142	70	63	0.57	1.36	111.3*
2-06	30.0	0.30	0.74	159.435	142	70	63	0.55	1.16	99.1
1-01	32.5	0.39	0.97	160.820	143	67	64	0.62	1.38	104.6
1-02	35.0	0.38	0.94	162.100	143	71	64	0.62	1.28	97.5
1-03	37.5	0.40	0.99	163.580	143	72	65	0.63	1.48	109.7
1-04	40.0	0.45	1.10	165.070	143	71	65	0.67	1.49	104.3
1-05	42.5	0.41	1.00	166.490	143	70	64	0.64	1.42	104.3
1-06	45.0	0.32	0.79	167.780	143	72	65	0.57	1.29	106.9
4-01	47.5	0.34	0.84	169.110	144	70	66	0.58	1.33	107.1
4-02	50.0	0.26	0.64	170.300	144	71	66	0.51	1.19	109.4
4-03	52.5	0.36	0.89	171.560	144	72	66	0.60	1.26	98.4
4-04	55.0	0.37	0.92	173.030	144	72	66	0.61	1.47	113.3*
4-05	57.5	0.29	0.72	174.150	143	74	67	0.54	1.12	97.1
4-06	60.0	0.27	0.67	175.350	143	74	67	0.52	1.20	107.8
Final	60.0		0.89375	32.27000	143.08333	66.12500		0.60109	32.27000	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6011	0.8938	32.2700	143.0833	66.1250				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

Test Method: USEPA OTM 029
Analyte: Hydrogen Cyanide

Location: FCCU Regenerator Vent
Test Run: 2
Client: Marathon
Project No: 12461
Source Area (ft^2): 132.73229
Meter Operator: J. Lopez 330
Probe Operator: A. Christiansen 534
Test Date: 3/18/14
Start Time: 17:56
Stop Time: 19:09
Leak Rate Before: 0.003 cfm @ 15 "Hg
Leak Rate After: 0.001 cfm @ 12 "Hg

Bar. Press. (in. Hg): 29.76
Static P: 0.2
O_2 (dry volume %): 2.90
CO_2 (dry volume %): 17.40
N_2+CO (dry volume %): 79.70

Nozzle ID No: 235-1
Nozzle Diameter (D_n): 0.235
Probe ID No: 67M5-6-10
Pitot C_p: 0.8320
Pitot Leak Check: ☑ Pass ☐ Fail

Meter Box ID. No: 66-21
Meter ΔH@: 1.75370
Meter Y_d: 0.98840

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s	Sample ΔH	Metered (dcf)	Stack T_s	Dry Gas Meter $T_{m\text{-}in}$	Dry Gas Meter $T_{m\text{-}out}$	$\sqrt{\Delta P_s}$ (calculated)	Volume (calculated)	Isokinetics (calculated)
	0.0	(in. H_2O)	(in. H_2O)	176.510	(°F)	(°F)	(°F)	($\sqrt{}$in. H_2O)	(ft^3)	(%)
4-01	2.5	0.39	0.76	177.800	142	74	77	0.62	1.29	108.1
4-02	5.0	0.40	0.78	179.090	142	74	77	0.63	1.29	106.8
4-03	7.5	0.42	0.81	180.410	142	74	76	0.65	1.32	106.7
4-04	10.0	0.42	0.81	181.740	147	75	77	0.65	1.33	107.8
4-05	12.5	0.36	0.70	183.000	142	75	76	0.60	1.26	109.9
4-06	15.0	0.32	0.62	184.210	142	75	76	0.57	1.21	111.9*
1-01	17.5	0.41	0.80	185.490	143	75	75	0.64	1.28	104.8
1-02	20.0	0.43	0.83	186.810	143	76	75	0.66	1.32	105.5
1-03	22.5	0.40	0.78	188.090	143	77	76	0.63	1.28	105.8
1-04	25.0	0.40	0.78	189.370	143	78	75	0.63	1.28	105.8
1-05	27.5	0.33	0.64	190.680	143	79	75	0.57	1.31	119.1*
1-06	30.0	0.33	0.64	191.780	143	80	76	0.57	1.10	99.8
2-01	32.5	0.41	0.80	193.080	143	76	76	0.64	1.30	106.3
2-02	35.0	0.41	0.80	194.370	143	78	76	0.64	1.29	105.3
2-03	37.5	0.40	0.78	195.660	144	80	77	0.63	1.29	106.4
2-04	40.0	0.38	0.74	196.930	143	79	76	0.62	1.27	107.5
2-05	42.5	0.37	0.72	198.260	143	80	76	0.61	1.33	114.0*
2-06	45.0	0.35	0.68	199.300	143	79	76	0.59	1.04	91.7
3-01	47.5	0.33	0.64	200.470	143	74	75	0.57	1.17	106.9
3-02	50.0	0.30	0.58	201.580	143	76	75	0.55	1.11	106.1
3-03	52.5	0.34	0.66	202.690	143	77	75	0.58	1.11	99.6
3-04	55.0	0.37	0.72	203.900	143	77	75	0.61	1.21	104.1
3-05	57.5	0.34	0.66	205.000	143	77	75	0.58	1.10	98.7
3-06	60.0	0.33	0.64	206.100	145	77	75	0.57	1.10	100.4
Final	60.0		0.72375	29.59000	143.08333	76.25000		0.60955	29.59000	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6096	0.7238	29.5900	143.0833	76.2500				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

Test Method: USEPA OTM 029
Analyte: Hydrogen Cyanide

Location: FCCU Regenerator Vent
Test Run: 3
Client: Marathon
Project No: 12461
Source Area (ft^2): 132.73229
Meter Operator: J. Lopez 330
Probe Operator: A. Christiansen 534
Test Date: 3/19/14
Start Time: 09:14
Stop Time: 10:23
Leak Rate Before: 0.003 cfm @ 15 "Hg
Leak Rate After: 0.004 cfm @ 12 "Hg

Bar. Press. (in. Hg): 29.96
Static P: 0.2
O_2 (dry volume %): 3.70
CO_2 (dry volume %): 17.50
N_2+CO (dry volume %): 78.80

Nozzle ID No: 235-1
Nozzle Diameter (D_n): 0.235
Probe ID No: 67M5-6-10
Pitot C_p: 0.8320
Pitot Leak Check: ☑ Pass ☐ Fail

Meter Box ID. No: 66-21
Meter ΔH@: 1.75370
Meter Y_d: 0.98840

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s (in. H_2O)	Sample ΔH (in. H_2O)	Metered (dcf)	Stack T_s (°F)	Dry Gas Meter $T_{m\text{-}in}$ (°F)	Dry Gas Meter $T_{m\text{-}out}$ (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{}$in. H_2O)	Volume (calculated) (ft^3)	Isokinetics (calculated) (%)
	0.0			209.285						
3-01	2.5	0.38	0.65	210.460	143	64	64	0.62	1.18	101.9
3-02	5.0	0.39	0.66	211.590	143	65	64	0.62	1.13	96.6
3-03	7.5	0.40	0.68	212.720	144	65	64	0.63	1.13	95.5
3-04	10.0	0.40	0.68	213.910	143	65	64	0.63	1.19	100.5
3-05	12.5	0.35	0.60	214.960	144	66	64	0.59	1.05	94.8
3-06	15.0	0.30	0.51	215.965	143	65	64	0.55	1.01	98.0
2-01	17.5	0.39	0.66	217.080	144	63	62	0.62	1.12	95.8
2-02	20.0	0.31	0.53	218.120	144	63	62	0.56	1.04	100.2
2-03	22.5	0.41	0.70	219.300	144	63	62	0.64	1.18	98.9
2-04	25.0	0.40	0.68	220.440	143	63	62	0.63	1.14	96.6
2-05	27.5	0.38	0.65	221.610	146	64	62	0.62	1.17	101.9
2-06	30.0	0.32	0.54	222.650	143	64	62	0.57	1.04	98.5
1-01	32.5	0.32	0.54	223.700	144	66	62	0.57	1.05	99.3
1-02	35.0	0.36	0.61	224.770	144	68	62	0.60	1.07	95.2
1-03	37.5	0.40	0.68	225.920	144	70	64	0.63	1.15	96.7
1-04	40.0	0.37	0.63	227.080	144	72	64	0.61	1.16	101.3
1-05	42.5	0.31	0.53	228.110	143	73	65	0.56	1.03	97.9
1-06	45.0	0.27	0.46	229.075	143	74	66	0.52	0.96	98.1
4-01	47.5	0.39	0.66	230.250	144	75	67	0.62	1.18	99.3
4-02	50.0	0.40	0.68	231.430	147	77	69	0.63	1.18	98.4
4-03	52.5	0.40	0.68	232.630	143	76	69	0.63	1.20	99.8
4-04	55.0	0.37	0.63	233.770	143	77	69	0.61	1.14	98.5
4-05	57.5	0.32	0.54	234.780	144	78	70	0.57	1.01	93.7
4-06	60.0	0.30	0.51	235.780	143	76	70	0.55	1.00	95.9
Final	60.0		0.61208	26.49500	143.75000	66.77083		0.59897	26.49500	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.5990	0.6121	26.4950	143.7500	66.7708				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

Test Method: **USEPA OTM 029**
Analyte: **Hydrogen Cyanide**

Location: FCCU Regenerator Vent
Test Run: 8
Client: Marathon
Project No: 12461
Source Area (ft^2): 132.73229
Meter Operator: J. Lopez 330
Probe Operator: A. Christiansen 534
Test Date: 3/21/14
Start Time: 08:23
Stop Time: 09:32
Leak Rate Before: 0.003 cfm @ 17 "Hg
Leak Rate After: 0.001 cfm @ 15 "Hg

Bar. Press. (in. Hg): 29.91
Static P: 0.2
O_2 (dry volume %): 2.30
CO_2 (dry volume %): 17.50
N_2+CO (dry volume %): 80.20
H_2O (condensate, ml or gm): 253.4
H_2O (silica, g): 10.6
Actual Moisture (%): 18.82

Nozzle ID No: 235-1
Nozzle Diameter (D_n): 0.235
Probe ID No: 67M5-6-10
Pitot C_p: 0.832
Pitot Leak Check: ☑ Pass ☐ Fail
Meter Box ID. No: 66-21
Meter ΔH@: 1.75370
Meter Y_d: 0.98840

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s	Sample ΔH	Metered	Stack	Dry Gas Meter		$\sqrt{\Delta P_s}$	Volume	Isokinetics
	0.0	(in. H_2O)	(in. H_2O)	(dcf) 347.550	T_s (°F)	$T_{m\text{-}in}$ (°F)	$T_{m\text{-}out}$ (°F)	(calculated) ($\sqrt{}$in. H_2O)	(calculated) (ft^3)	(calculated) (%)
4-01	2.5	0.38	0.65	348.710	143	69	67	0.62	1.16	96.9
4-02	5.0	0.40	0.68	349.870	143	70	67	0.63	1.16	94.4
4-03	7.5	0.40	0.68	351.010	143	72	68	0.63	1.14	92.5
4-04	10.0	0.38	0.65	352.190	143	74	68	0.62	1.18	98.0
4-05	12.5	0.31	0.53	353.300	143	74	69	0.56	1.11	102.0
4-06	15.0	0.30	0.51	354.325	143	74	69	0.55	1.02	95.7
1-01	17.5	0.39	0.66	355.480	143	74	70	0.62	1.16	94.5
1-02	20.0	0.40	0.68	356.680	143	75	71	0.63	1.20	96.8
1-03	22.5	0.43	0.73	357.910	143	77	71	0.66	1.23	95.5
1-04	25.0	0.41	0.70	359.090	143	78	71	0.64	1.18	93.8
1-05	27.5	0.36	0.61	360.220	143	78	72	0.60	1.13	95.7
1-06	30.0	0.35	0.59	361.330	142	79	73	0.59	1.11	95.1
2-01	32.5	0.38	0.65	362.490	143	79	73	0.62	1.16	95.5
2-02	35.0	0.40	0.68	363.640	143	79	74	0.63	1.15	92.2
2-03	37.5	0.38	0.65	364.770	143	80	74	0.62	1.13	92.8
2-04	40.0	0.37	0.63	365.950	143	81	75	0.61	1.18	98.0
2-05	42.5	0.32	0.54	367.050	143	82	75	0.57	1.10	98.2
2-06	45.0	0.30	0.51	368.090	143	82	76	0.55	1.04	95.7
3-01	47.5	0.39	0.66	369.260	143	80	76	0.62	1.17	94.7
3-02	50.0	0.40	0.68	370.480	143	82	77	0.63	1.22	97.2
3-03	52.5	0.42	0.71	371.590	143	82	77	0.65	1.11	86.3*
3-04	55.0	0.29	0.49	372.650	143	83	77	0.54	1.06	99.1
3-05	57.5	0.31	0.53	373.660	143	82	77	0.56	1.01	91.4
3-06	60.0	0.32	0.54	374.715	143	83	78	0.57	1.05	93.8
Final	60.0		0.62250	27.16500	142.95833	75.29167		0.60416	27.16500	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6042	0.6225	27.1650	142.9583	75.2917				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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USEPA Method 3 Laboratory Data

Test Method: USEPA OTM 029
Analyte: Hydrogen Cyanide

Location: FCCU Regenerator Vent
Client: Marathon
Project No: 12461
Method: EPA Method 3A
Fuel Type: Select Fuel
F_o for Fuel: N/A

Analyst: S. Lehmann
Analyst Emp No: 514

Run Number	Trial	Percent CO_2	Percent O_2+CO_2	Percent O_2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
4	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		7.00000		10.00000	83.00000	29.52000	1.55714	☐ Fo value within expected range.

Run Number	Trial	Percent CO2	Percent O2+CO2	Percent O2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
5	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		12.50000		2.30000	85.20000	30.09200	1.48800	☐ Fo value within expected range.

Run Number	Trial	Percent CO2	Percent O2+CO2	Percent O2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
6	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		13.00000		1.80000	85.20000	30.15200	1.46923	☐ Fo value within expected range.

Run Number	Trial	Percent CO2	Percent O2+CO2	Percent O2	Percent N_2	Dry Mol. Weight	F_o	Method of Analysis: CEM
7	1							
	2							
	3							
	Avg.							
CEM or Other Avg:		11.30000		3.60000	85.10000	29.95200	1.53097	☐ Fo value within expected range.

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USEPA Method 4 Laboratory Data

Location: FCCU Regenerator Vent
Client: Marathon
Project No: 12461

Test Method: USEPA OTM 029
Analyte: Hydrogen Cyanide
Analyst: C. Murdock
Analyst Emp No: 628

Test Run: 4

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	760.0	649.6	110.4
Impinger 2	200 ml 6N NaOH	667.8	651.5	16.3
Impinger 3	200 ml 6N NaOH	678.2	656.2	22.0
Impinger 4	200 ml 6N NaOH	649.2	636.5	12.7
Impinger 5	100 ml 6N NaOH	541.3	533.6	7.7
Impinger 6	Silica Gel	671.1	666.2	4.9
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
169.1	Liquid (gm)		
0.0	less rinse (gm)		
169.1	Net Liquid (gm)	169.1	☑ QA/QC OK
+ 4.9	Silica Gel (gm)	4.9	☑ QA/QC OK
174.0	Total Vlc (gm)	174.0	☑ QA/QC OK

Test Run: 5

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	819.9	654.4	165.5
Impinger 2	200 ml 6N NaOH	687.6	648.4	39.2
Impinger 3	200 ml 6N NaOH	653.2	632.9	20.3
Impinger 4	200 ml 6N NaOH	648.3	632.1	16.2
Impinger 5	100 ml 6N NaOH	542.0	534.9	7.1
Impinger 6	Silica Gel	762.7	757.1	5.6
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
248.3	Liquid (gm)		
0.0	less rinse (gm)		
248.3	Net Liquid (gm)	248.3	☑ QA/QC OK
+ 5.6	Silica Gel (gm)	5.6	☑ QA/QC OK
253.9	Total Vlc (gm)	253.9	☑ QA/QC OK

Test Run: 6

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1	Empty	823.3	656.3	167.0
Impinger 2	200 ml 6N NaOH	672.1	635.1	37.0
Impinger 3	200 ml 6N NaOH	685.6	662.2	23.4
Impinger 4	200 ml 6N NaOH	684.0	648.5	35.5
Impinger 5	100 ml 6N NaOH		536.7	
Impinger 6	Silica Gel		769.8	
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
227.4	Liquid (gm)		
0.0	less rinse (gm)		
227.4	Net Liquid (gm)	227.4	☑ QA/QC OK
+ 35.5	Silica Gel (gm)	35.5	☑ QA/QC OK
262.9	Total Vlc (gm)	262.9	☑ QA/QC OK

Test Run: 7

	Contents	Gross (gm)	Tare (gm)	Net (gm)
Impinger 1		799.3	659.6	139.7
Impinger 2		668.1	637.4	30.7
Impinger 3		679.9	662.0	17.9
Impinger 4		656.9	636.9	20.0
Impinger 5		560.6	557.6	3.0
Impinger 6		778.6	775.9	2.7
Impinger 7				
Impinger 8				

Rinse: (ml or gm)

		Field Data Check	
211.3	Liquid (gm)		
0.0	less rinse (gm)		
211.3	Net Liquid (gm)	211.3	☑ QA/QC OK
+ 2.7	Silica Gel (gm)	2.7	☑ QA/QC OK
214.0	Total Vlc (gm)	214.0	☑ QA/QC OK

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Field Data Printout

Test Method: USEPA OTM 029
Analyte: Hydrogen Cyanide

Location: FCCU Regenerator Vent
Test Run: 4
Client: Marathon
Project No: 12461
Source Area (ft^2): 132.73229
Meter Operator: J. Lopez 330
Probe Operator: A. Christiansen 534
Test Date: 3/19/14
Start Time: 11:23
Stop Time: 12:32
Leak Rate Before: 0.002 cfm @ 16 "Hg
Leak Rate After: 0.050 @ 10 "Hg

Bar. Press. (in. Hg): 29.96
Static P: 0.2
O_2 (dry volume %): 10.00
CO_2 (dry volume %): 15.10
N_2+CO (dry volume %): 74.90

Nozzle ID No: 235-1
Nozzle Diameter (D_n): 0.235
Probe ID No: 67M5-6-10
Pitot C_p: 0.8320
Pitot Leak Check: ☑ Pass ☐ Fail

Meter Box ID. No: 66-21
Meter ΔH@: 1.75370
Meter Y_d: 0.98840

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s	Sample ΔH	Metered	Stack	Dry Gas Meter		$\sqrt{\Delta P_s}$	Volume	Isokinetics
				(dcf)	T_s	$T_{m\text{-}in}$	$T_{m\text{-}out}$	(calculated)	(calculated)	(calculated)
	0.0	(in. H_2O)	(in. H_2O)	236.030	(°F)	(°F)	(°F)	($\sqrt{}$in. H_2O)	(ft^3)	(%)
4-01	2.5	0.39	0.66	237.250	144	70	70	0.62	1.22	101.7
4-02	5.0	0.36	0.61	238.350	146	71	70	0.60	1.10	95.5
4-03	7.5	0.36	0.61	239.500	144	72	70	0.60	1.15	99.6
4-04	10.0	0.36	0.61	240.590	144	72	70	0.60	1.09	94.4
4-05	12.5	0.27	0.46	241.550	147	74	71	0.52	0.96	95.9
4-06	15.0	0.27	0.46	242.525	144	75	71	0.52	0.97	97.1
1-01	17.5	0.38	0.65	243.720	143	74	71	0.62	1.19	100.3
1-02	20.0	0.39	0.66	244.900	143	76	71	0.62	1.18	97.6
1-03	22.5	0.41	0.70	246.110	143	77	72	0.64	1.21	97.5
1-04	25.0	0.41	0.70	247.310	143	77	72	0.64	1.20	96.7
1-05	27.5	0.35	0.60	248.460	143	76	72	0.59	1.15	100.3
1-06	30.0	0.30	0.51	249.470	143	76	72	0.55	1.01	95.2
2-01	32.5	0.40	0.68	250.670	143	74	72	0.63	1.20	98.1
2-02	35.0	0.28	0.48	251.630	143	77	72	0.53	0.96	93.5
2-03	37.5	0.38	0.65	252.820	144	77	72	0.62	1.19	99.6
2-04	40.0	0.38	0.65	254.010	144	78	73	0.62	1.19	99.4
2-05	42.5	0.36	0.61	255.080	143	79	73	0.60	1.07	91.7
2-06	45.0	0.32	0.54	256.170	144	81	74	0.57	1.09	98.9
3-01	47.5	0.38	0.65	257.350	144	77	74	0.62	1.18	98.6
3-02	50.0	0.30	0.51	258.400	143	78	74	0.55	1.05	98.6
3-03	52.5	0.29	0.49	259.480	144	80	74	0.54	1.08	103.0
3-04	55.0	0.37	0.63	260.600	143	80	75	0.61	1.12	94.4
3-05	57.5	0.35	0.60	261.830	143	81	75	0.59	1.23	106.5
3-06	60.0	0.29	0.49	262.790	143	81	76	0.54	0.96	91.2
Final	60.0		0.59208	24.830 *	143.66667	74.35417		0.58858	24.83040	
24 points sampled		Sq.Rt.ΔP		* Net meter volume corrected for final leak rate.						
QC-Check: Field Averages		0.5886	0.5921	26.7600	143.6667	74.3542				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

Test Method: **USEPA OTM 029**
Analyte: **Hydrogen Cyanide**

Location: FCCU Regenerator Vent
Test Run: 5
Client: Marathon
Project No: 12461
Source Area (ft^2): 132.73229
Meter Operator: J. Lopez 330
Probe Operator: A. Christiansen 534
Test Date: 3/19/14
Start Time: 13:27
Stop Time: 14:38
Leak Rate Before: 0.001 cfm @ 16 "Hg
Leak Rate After: 0.003 cfm @ 10 "Hg

Bar. Press. (in. Hg): 29.96
Static P: 0.2
O_2 (dry volume %): 2.30
CO_2 (dry volume %): 16.80
N_2+CO (dry volume %): 80.90

Nozzle ID No: 235-1
Nozzle Diameter (D_n): 0.235
Probe ID No: 67M5-6-10
Pitot C_p: 0.832
Pitot Leak Check: ☑ Pass ☐ Fail

Meter Box ID. No: 66-21
Meter ΔH@: 1.75370
Meter Y_d: 0.98840

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s	Sample ΔH	Metered (dcf)	Stack T_s	Dry Gas Meter $T_{m\text{-}in}$	Dry Gas Meter $T_{m\text{-}out}$	$\sqrt{\Delta P_s}$ (calculated)	Volume (calculated)	Isokinetics (calculated)
	0.0	(in. H_2O)	(in. H_2O)	263.500	(°F)	(°F)	(°F)	($\sqrt{}$in. H_2O)	(ft^3)	(%)
3-01	2.5	0.40	0.68	264.690	144	80	77	0.63	1.19	96.0
3-02	5.0	0.42	0.71	265.890	143	81	77	0.65	1.20	94.3
3-03	7.5	0.40	0.68	267.090	143	83	78	0.63	1.20	96.4
3-04	10.0	0.40	0.68	268.240	143	85	79	0.63	1.15	92.1
3-05	12.5	0.36	0.61	269.290	143	85	79	0.60	1.05	88.6*
3-06	15.0	0.31	0.53	270.285	143	85	79	0.56	1.00	90.5
2-01	17.5	0.39	0.66	271.410	143	83	80	0.62	1.13	91.3
2-02	20.0	0.39	0.66	272.580	143	85	80	0.62	1.17	94.8
2-03	22.5	0.40	0.68	273.840	143	85	81	0.63	1.26	100.7
2-04	25.0	0.38	0.65	274.910	143	86	81	0.62	1.07	87.7*
2-05	27.5	0.31	0.53	276.000	143	85	82	0.56	1.09	98.9
2-06	30.0	0.31	0.53	277.000	143	85	81	0.56	1.00	90.8
1-01	32.5	0.39	0.66	278.120	143	85	81	0.62	1.12	90.7
1-02	35.0	0.40	0.68	279.280	142	86	82	0.63	1.16	92.5
1-03	37.5	0.40	0.68	280.450	143	87	82	0.63	1.17	93.3
1-04	40.0	0.40	0.68	281.620	143	90	83	0.63	1.17	92.9
1-05	42.5	0.35	0.60	282.750	142	92	84	0.59	1.13	95.6
1-06	45.0	0.35	0.60	283.870	143	91	84	0.59	1.12	94.9
4-01	47.5	0.39	0.66	285.030	143	88	85	0.62	1.16	93.3
4-02	50.0	0.40	0.68	286.190	143	88	85	0.63	1.16	92.1
4-03	52.5	0.40	0.68	287.350	143	87	85	0.63	1.16	92.2
4-04	55.0	0.41	0.70	288.610	143	86	85	0.64	1.26	99.1
4-05	57.5	0.35	0.60	289.690	143	85	84	0.59	1.08	92.0
4-06	60.0	0.28	0.48	290.660	143	85	83	0.53	0.97	92.5
Final	60.0		0.63750	27.16000	142.95833	83.64583		0.61122	27.16000	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6112	0.6375	27.1600	142.9583	83.6458				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

Test Method: USEPA OTM 029
Analyte: Hydrogen Cyanide

Location: FCCU Regenerator Vent
Test Run: 6
Client: Marathon
Project No: 12461
Source Area (ft^2): 132.73229

Meter Operator: J. Lopez 330
Probe Operator: A. Christiansen 534
Test Date: 3/19/14
Start Time: 15:31
Stop Time: 16:41
Leak Rate Before: 0.001 cfm @ 15 "Hg
Leak Rate After: 0.001 cfm @ 8 "Hg

Bar. Press. (in. Hg): 29.96
Static P: 0.2
O_2 (dry volume %): 1.80
CO_2 (dry volume %): 17.90
N_2+CO (dry volume %): 80.30

Nozzle ID No: 235-1
Nozzle Diameter (D_n): 0.235
Probe ID No: 67M5-6-10
Pitot C_p: 0.832
Pitot Leak Check: ☑ Pass ☐ Fail

Meter Box ID. No: 66-21
Meter ΔH@: 1.75370
Meter Y_d: 0.98840

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s	Sample ΔH	Metered	Stack T_s	Dry Gas Meter $T_{m\text{-}in}$	Dry Gas Meter $T_{m\text{-}out}$	$\sqrt{\Delta P_s}$ (calculated)	Volume (calculated)	Isokinetics (calculated)
	0.0	(in. H_2O)	(in. H_2O)	291.220	(°F)	(°F)	(°F)	($\sqrt{}$in. H_2O)	(ft^3)	(%)
4-01	2.5	0.38	0.65	292.400	143	86	85	0.62	1.18	98.1
4-02	5.0	0.38	0.65	293.560	142	87	85	0.62	1.16	96.3
4-03	7.5	0.39	0.66	294.740	145	90	86	0.62	1.18	96.6
4-04	10.0	0.37	0.63	295.900	143	90	86	0.61	1.16	97.3
4-05	12.5	0.31	0.53	297.065	143	89	86	0.56	1.17	106.8
4-06	15.0	0.29	0.49	298.100	142	90	87	0.54	1.04	97.9
1-01	17.5	0.38	0.65	299.230	143	89	86	0.62	1.13	93.6
1-02	20.0	0.39	0.66	300.410	143	89	87	0.62	1.18	96.4
1-03	22.5	0.38	0.65	301.670	143	89	87	0.62	1.26	104.3
1-04	25.0	0.37	0.63	302.770	143	89	86	0.61	1.10	92.4
1-05	27.5	0.28	0.48	303.740	142	89	86	0.53	0.97	93.5
1-06	30.0	0.28	0.48	304.730	143	89	86	0.53	0.99	95.5
2-01	32.5	0.38	0.65	305.880	143	87	86	0.62	1.15	95.5
2-02	35.0	0.36	0.61	307.050	143	87	86	0.60	1.17	99.8
2-03	37.5	0.40	0.68	308.170	143	86	85	0.63	1.12	90.8
2-04	40.0	0.40	0.68	309.360	143	85	85	0.63	1.19	96.5
2-05	42.5	0.37	0.63	310.460	143	84	84	0.61	1.10	93.0
2-06	45.0	0.35	0.60	311.580	143	85	84	0.59	1.12	97.2
3-01	47.5	0.38	0.65	312.710	143	84	83	0.62	1.13	94.3
3-02	50.0	0.40	0.68	313.900	143	84	83	0.63	1.19	96.8
3-03	52.5	0.40	0.68	315.080	143	85	83	0.63	1.18	95.9
3-04	55.0	0.38	0.65	316.230	142	85	83	0.62	1.15	95.8
3-05	57.5	0.38	0.65	317.370	143	86	83	0.62	1.14	95.0
3-06	60.0	0.36	0.61	318.500	142	86	83	0.60	1.13	96.6
Final	60.0		0.62208	27.28000	142.87500	86.06250		0.60335	27.28000	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6033	0.6221	27.2800	142.8750	86.0625				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Field Data Printout

Test Method: USEPA OTM 029
Analyte: Hydrogen Cyanide

Location: FCCU Regenerator Vent
Test Run: 7
Client: Marathon
Project No: 12461
Source Area (ft^2): 132.73229
Meter Operator: J. Lopez 330
Probe Operator: A. Christiansen 534
Test Date: 3/20/14
Start Time: 09:31
Stop Time: 11:11
Leak Rate Before: 0.001 cfm @ 16 "Hg
Leak Rate After: 0.001 cfm @ 9 "Hg

Bar. Press. (in. Hg): 29.96
Static P: 0.2
O_2 (dry volume %): 3.60
CO_2 (dry volume %): 18.00
N_2+CO (dry volume %): 78.40
H_2O (condensate, ml or gm): 211.3
H_2O (silica, g): 2.7
Actual Moisture (%): 20.37

Nozzle ID No: 235-1
Nozzle Diameter (D_n): 0.235
Probe ID No: 67M5-6-10
Pitot C_p: 0.832
Pitot Leak Check: ☑ Pass ☐ Fail
Meter Box ID. No: 66-21
Meter ΔH@: 1.75370
Meter Y_d: 0.98840

Traverse Point	Run Time 2.5 min/read	Pitot ΔP_s	Sample ΔH	Metered	Stack	Dry Gas Meter		$\sqrt{\Delta P_s}$	Volume	Isokinetics
				(dcf)	T_s	$T_{m\text{-}in}$	$T_{m\text{-}out}$	(calculated)	(calculated)	(calculated)
	0.0	(in. H_2O)	(in. H_2O)	320.015	(°F)	(°F)	(°F)	($\sqrt{in.}$ H_2O)	(ft^3)	(%)
3-01	2.5	0.40	0.68	321.220	142	67	67	0.63	1.21	100.1
3-02	5.0	0.41	0.70	322.430	142	68	67	0.64	1.21	99.1
3-03	7.5	0.41	0.70	323.600	142	68	67	0.64	1.17	95.9
3-04	10.0	0.38	0.65	324.740	142	69	67	0.62	1.14	96.9
3-05	12.5	0.36	0.61	325.870	147	70	67	0.60	1.13	99.0
3-06	15.0	0.32	0.54	326.920	142	70	67	0.57	1.05	97.2
2-01	17.5	0.38	0.65	328.070	142	69	67	0.62	1.15	97.8
2-02	20.0	0.39	0.66	329.250	143	71	67	0.62	1.18	98.9
2-03	22.5	0.37	0.63	330.400	143	71	68	0.61	1.15	98.9
2-04	25.0	0.37	0.63	331.690	142	72	67	0.61	1.29	110.8*
2-05	27.5	0.30	0.51	332.580	143	73	68	0.55	0.89	84.8*
2-06	30.0	0.29	0.49	333.535	143	74	68	0.54	0.96	92.5
1-01	32.5	0.38	0.65	334.670	143	73	69	0.62	1.13	96.0
1-02	35.0	0.40	0.68	335.880	143	73	70	0.63	1.21	99.7
1-03	37.5	0.40	0.68	337.050	143	73	70	0.63	1.17	96.4
1-04	40.0	0.38	0.65	338.220	143	74	70	0.62	1.17	98.8
1-05	42.5	0.35	0.60	339.320	143	75	70	0.59	1.10	96.7
1-06	45.0	0.35	0.60	340.485	143	75	70	0.59	1.17	102.4
4-01	47.5	0.42	0.71	341.680	143	73	70	0.65	1.19	96.1
4-02	50.0	0.38	0.65	342.820	143	71	70	0.62	1.14	96.5
4-03	52.5	0.37	0.63	344.000	143	72	70	0.61	1.18	101.2
4-04	55.0	0.37	0.63	345.120	143	72	70	0.61	1.12	96.0
4-05	57.5	0.31	0.53	346.180	143	74	71	0.56	1.06	99.0
4-06	60.0	0.30	0.51	347.155	143	75	71	0.55	0.97	92.5
Final	60.0		0.62375	27.14000	142.87500	70.20833		0.60440	27.14000	
24 points sampled		Sq.Rt.ΔP								
QC-Check: Field Averages		0.6044	0.6238	27.1400	142.8750	70.2083				
		☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK	☑ Avg. OK				

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Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Velocity Decay Determination

Location: FCCU Regenerator Vent
Test Run: 1
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Meter Operator: A. Christiansen
Probe Operator: I. Lopez
Test Date: 3/18/14
Start Time: 10:10
Stop Time: 10:33

Pitot C_p:
Static P:
Bar. Press. (in. Hg):
Moisture (%)[1]:
O_2 (dry volume %)':
CO_2 (dry volume %)':

Traverse Point	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	Unadjusted Velocity (calculated) ft/sec	Adjusted Velocity (calculated) ft/sec	
1-01		143		36.2	36.2	
1-02		143		31.5	31.5	
1-03		143		34.6	34.6	
1-04		143		29.9	29.9	
1-05		143		31.6	31.6	
1-06		143		27.3	22.0	Replacement Velocity
2-01		144		36.4	36.4	
2-02		144		38.3	38.3	
2-03		144		33.2	33.2	
2-04		144		36.1	36.1	
2-05		144		33.5	33.5	
2-06		143		27.1	21.0	Replacement Velocity
3-01		144		35.3	35.3	
3-02		144		37.2	37.2	
3-03		144		38.1	38.1	
3-04		145		37.5	37.5	
3-05		144		32.9	32.9	
3-06		143		23.2	17.0	Replacement Velocity
4-01		144		37.8	37.8	
4-02		144		38.4	38.4	
4-03		144		38.5	38.5	
4-04		143		33.7	33.7	
4-05		143		29.7	29.7	
4-06		142		16.1	16.7	Replacement Velocity
Final		143.5		33.1	32.4	

WAF - Calculated **0.9784**
WAF - Actual **0.9784**
WAF - Actual (avg) **0.9778**

Revision 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 1
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40254	
Port:	1	
Duct Side:	NA	

Pitot C_p: 0.000
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E) Intermediate Calculations (in^2)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d1-06	1.0		142		6.8	3.41	4,778.36	4,656.63	121.74	414.78
d1-05	2.0		143		20.1	13.45	4,656.63	4,536.46	120.17	1,615.90
d1-04	3.0		143		27.3	23.68	4,536.46	4,417.86	118.60	2,807.83
d1-03	4.0		143		27.2	27.23	4,417.86	4,300.84	117.02	3,186.98
d1-02	5.0		143		29.2	28.21	4,300.84	4,185.39	115.45	3,256.89
d1-01	6.0		143		31.3	30.28	4,185.39	4,071.50	113.88	3,448.67
d_{rem}	6.0		143		31.3					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	14,731.04
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	31.34
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,806.18
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	17,537.22
b. 'Replacement velocity' for Port 1 (ft/sec.)	**22.02**

[1] Data obtained from Sample Train: 0
Test Run: 0

Revision 0

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 1
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Pitot C_p: 0.000
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40254	
Port:	2	
Duct Side:	NA	

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d2-06	1.0		131		0.0	0.0	4,778.36	4,656.63	121.74	1
d2-05	2.0		143		19.0	9.5	4,656.63	4,536.46	120.17	1,140
d2-04	3.0		143		27.1	23.0	4,536.46	4,417.86	118.60	2,733
d2-03	4.0		143		29.2	28.2	4,417.86	4,300.84	117.02	3,297
d2-02	5.0		143		29.2	29.2	4,300.84	4,185.39	115.45	3,376
d2-01	6.0		143		30.6	29.9	4,185.39	4,071.50	113.88	3,410
d_{rem}	6.0		143		30.6					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	13,956.30
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	30.64
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,743.04
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	16,699.34
b. 'Replacement velocity' for Port 2 (ft/sec.)	**20.97**

[1] Data obtained from Sample Train: 0
Test Run: 0

Revision 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 1
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40254	
Port:	3	
Duct Side:	NA	

Pitot C_p: 0.000
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E) Intermediate Calculations (in^2)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d3-06	1.0		142		4.2	2.1	4,778.36	4,656.63	121.74	258
d3-05	2.0		143		4.0	4.1	4,656.63	4,536.46	120.17	493
d3-04	3.0		143		23.2	13.6	4,536.46	4,417.86	118.60	1,614
d3-03	4.0		143		23.5	23.4	4,417.86	4,300.84	117.02	2,737
d3-02	5.0		143		26.3	24.9	4,300.84	4,185.39	115.45	2,874
d3-01	6.0		143		27.5	26.9	4,185.39	4,071.50	113.88	3,062
d_{rem}	6.0		143		27.5					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	11,038.23
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	27.50
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,462.53
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	13,500.76
b. 'Replacement velocity' for Port 3 (ft/sec.)	**16.95**

[1] Data obtained from Sample Train: 0
Test Run: 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 1
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator: A. Christiansen 534
Probe Operator: I. Lopez 330
Test Date: 40254
Port:
Duct Side: NA

Pitot C_p: 0.00
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d4-06	1.0		125		7.7	3.8	4,778.36	4,656.63	121.74	467
d4-05	2.0		133		7.4	7.5	4,656.63	4,536.46	120.17	904
d4-04	3.0		142		16.1	11.7	4,536.46	4,417.86	118.60	1,391
d4-03	4.0		143		23.0	19.6	4,417.86	4,300.84	117.02	2,288
d4-02	5.0		143		26.9	24.9	4,300.84	4,185.39	115.45	2,880
d4-01	6.0		143		26.0	26.4	4,185.39	4,071.50	113.88	3,009
d_{rem}	6.0		143		26.0					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	10,938.00
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	25.97
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,324.84
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	13,262.84
b. 'Replacement velocity' for Port (ft/sec.)	**16.65**

[1] Data obtained from Sample Train: 0
Test Run: 0

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 1 Condition 1
Personnel:	A Christiansen
Date:	Tuesday, 3/18/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	11
Dry Gas Molecular Weight [g/mol]:	30.88
Water Vapor Volume Fraction, Bws [-]:	0.22022852
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1772.7

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	820,505	227.92
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	12,960,894	216,015
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	11,302,054	188,368
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	8,813,019	146,884

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	0.0	38.5	27.1	27.1
Temperature [°F]:	125.4	144.7	142.4	143.2
Wet Gas Density [lbm/ft^3]:	0.0631	0.0652	0.0634	
Static Pressure [IWC]:	-0.50	-0.03	-0.10	-0.10
Total Pressure [IWC]:	-0.23	0.19	0.07	0.10
Barometric Pressure ["Hg at 32°F]:	29.75	29.76	29.76	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 10:10 AM End Time: 10:34 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/18/14 09:55 AM	15	15.61	15.66

Probe Used	Generic_Uncalibrated
Rslo	0
Probe Calibration Date	3/11/2014

	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	-0.002	0.002	0.000	0.000	0.01	9:18 AM
POST	0.000	0.001	-0.010	0.000	0.001	0.02	10:35 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes e
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 10:10 AM End Time: 10:34 AM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.15	10:32 AM	3.02	29.76	0.220	0.004	-0.003	0.14	143.4	-3.4
1	2	0.00	0.46	10:32 AM	3.02	29.76	0.166	0.104	-0.013	0.13	143.5	4.4
1	3	0.00	0.79	10:32 AM	3.02	29.76	0.199	0.066	-0.008	0.18	143.4	1.2
1	4	0.00	1.13	10:32 AM	3.02	29.76	0.151	0.117	-0.011	0.15	143.2	7.2
1	5	0.00	1.50	10:33 AM	3.02	29.76	0.167	0.023	-0.005	0.12	143.0	-0.2
1	6	0.00	1.90	10:33 AM	3.02	29.76	0.165	-0.035	-0.003	0.09	143.1	-4.8
1	7	0.00	2.34	10:33 AM	3.02	29.76	0.143	-0.002	0.001	0.09	143.0	-1.0
1	8	0.00	2.83	10:33 AM	3.02	29.76	0.124	0.000	0.006	0.06	143.0	-1.0
1	9	0.00	3.40	10:33 AM	3.02	29.76	0.129	-0.039	0.014	0.07	142.9	-6.8
1	10	0.00	4.10	10:33 AM	3.02	29.76	0.068	-0.029	-0.010	0.04	142.5	-7.2
1	11	0.00	5.12	10:34 AM	3.02	29.76	0.008	-0.019	-0.035	-0.04	142.4	0.1
2	1	90.00	0.15	10:27 AM	3.02	29.76	0.221	0.011	-0.007	0.18	143.9	-1.7
2	2	90.00	0.46	10:27 AM	3.02	29.76	0.247	-0.036	-0.007	0.17	143.7	-5.2
2	3	90.00	0.79	10:28 AM	3.02	29.76	0.184	0.100	-0.007	0.16	143.8	2.5
2	4	90.00	1.13	10:28 AM	3.02	29.76	0.217	0.025	-0.005	0.16	143.8	-1.7
2	5	90.00	1.50	10:28 AM	3.02	29.76	0.188	0.012	0.001	0.14	143.7	-1.8
2	6	90.00	1.90	10:28 AM	3.02	29.76	0.157	0.020	-0.001	0.10	143.4	-1.3
2	7	90.00	2.34	10:28 AM	3.02	29.76	0.143	0.017	0.002	0.06	143.1	-1.8
2	8	90.00	2.83	10:29 AM	3.02	29.76	0.144	0.017	0.006	0.06	143.2	-2.4
2	9	90.00	3.40	10:29 AM	3.02	29.76	0.128	0.008	0.009	0.03	142.9	-2.3
2	10	90.00	4.10	10:31 AM	3.02	29.76	0.063	0.000	0.001	-0.04	142.7	-1.1
2	11	90.00	5.12	10:31 AM	3.02	29.76	0.000	-0.009	-0.011	-0.05	131.0	-19.5
3	1	180.00	0.15	10:21 AM	3.02	29.76	0.208	0.023	-0.005	0.16	143.5	-3.1
3	2	180.00	0.46	10:22 AM	3.02	29.75	0.233	-0.006	-0.004	0.18	143.6	-5.0
3	3	180.00	0.79	10:22 AM	3.02	29.76	0.243	-0.001	-0.002	0.15	143.8	-3.7
3	4	180.00	1.13	10:22 AM	3.02	29.76	0.234	-0.005	-0.013	-0.23	144.7	-4.4
3	5	180.00	1.50	10:23 AM	3.02	29.76	0.182	-0.014	-0.007	0.11	143.8	-5.7
3	6	180.00	1.90	10:23 AM	3.02	29.76	0.126	0.038	-0.004	0.10	143.4	-0.1
3	7	180.00	2.34	10:24 AM	3.02	29.75	0.115	0.043	0.002	0.06	143.1	0.7
3	8	180.00	2.83	10:24 AM	3.02	29.75	0.113	0.026	0.037	0.05	143.2	-0.6
3	9	180.00	3.40	10:24 AM	3.02	29.75	0.101	0.028	0.024	0.05	143.1	0.1
3	10	180.00	4.10	10:25 AM	3.02	29.75	0.003	0.002	0.077	-0.08	143.1	-2.5
3	11	180.00	5.12	10:26 AM	3.02	29.76	0.003	-0.012	-0.001	-0.10	142.2	-0.9
4	1	270.00	0.15	10:10 AM	3.02	29.75	0.246	-0.009	0.025	0.15	143.9	-6.0
4	2	270.00	0.46	10:10 AM	3.02	29.75	0.247	-0.037	-0.025	0.19	143.8	-6.5
4	3	270.00	0.79	10:11 AM	3.02	29.75	0.248	0.031	0.003	0.19	143.8	-0.9
4	4	270.00	1.13	10:12 AM	3.02	29.76	0.241	-0.001	0.086	0.18	143.5	-3.9
4	5	270.00	1.50	10:13 AM	3.02	29.75	0.157	-0.036	0.133	0.06	143.6	-9.8
4	6	270.00	1.90	10:17 AM	3.02	29.75	0.112	0.003	-0.004	0.05	143.0	-2.5
4	7	270.00	2.34	10:17 AM	3.02	29.75	0.120	0.028	-0.006	0.05	143.0	0.0
4	8	270.00	2.83	10:18 AM	3.02	29.75	0.088	0.024	-0.008	0.04	142.9	0.5
4	9	270.00	3.40	10:18 AM	3.02	29.76	0.057	0.008	0.022	0.01	141.8	2.5
4	10	270.00	4.10	10:20 AM	3.02	29.76	0.011	-0.019	-0.008	-0.09	133.1	8.1
4	11	270.00	5.12	10:19 AM	3.02	29.76	0.012	-0.021	-0.009	-0.11	125.4	-2.5

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 10:10 AM End Time: 10:34 AM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-3.4	-0.015	0.2	1.065	0.249	-0.10	0.0633	36.3	36.2	0.1	-2.1	24,905	393,498	331,186
4.4	-0.078	-4.2	1.070	0.190	-0.06	0.0633	31.7	31.5	-2.3	2.4	21,680	342,566	288,300
1.2	-0.040	-1.6	1.067	0.226	-0.05	0.0633	34.6	34.6	-0.9	0.7	23,753	375,307	315,862
7.2	-0.073	-3.8	1.069	0.173	-0.03	0.0633	30.2	29.9	-2.0	3.8	20,571	324,886	273,552
-0.2	-0.028	-0.7	1.066	0.189	-0.07	0.0633	31.6	31.6	-0.4	-0.1	21,748	343,398	289,208
-4.8	-0.021	-0.2	1.065	0.187	-0.10	0.0633	31.5	31.3	-0.1	-2.6	21,552	340,367	286,598
-1.0	0.007	1.8	1.064	0.162	-0.07	0.0633	29.2	29.2	0.9	-0.5	20,102	317,366	267,316
-1.0	0.046	4.6	1.064	0.141	-0.08	0.0633	27.3	27.2	2.2	-0.5	18,707	295,341	248,761
-6.8	0.109	9.2	1.066	0.147	-0.07	0.0634	27.8	27.3	4.5	-3.3	18,762	296,166	249,501
-7.2	-0.151	-8.9	1.079	0.079	-0.04	0.0634	20.5	20.1	-3.2	-2.5	13,823	218,067	183,815
0.1	-4.353	40.0	1.363	0.015	-0.05	0.0634	8.9	6.8	5.7	0.0	4,692	74,004	62,397
-1.7	-0.032	-1.0	1.066	0.251	-0.07	0.0632	36.5	36.4	-0.7	-1.1	25,025	395,664	332,781
-5.2	-0.030	-0.9	1.066	0.280	-0.11	0.0633	38.5	38.3	-0.6	-3.5	26,339	416,410	350,251
2.5	-0.035	-1.2	1.068	0.209	-0.05	0.0633	33.3	33.2	-0.7	1.4	22,834	360,988	303,640
-1.7	-0.024	-0.5	1.065	0.247	-0.09	0.0633	36.1	36.1	-0.3	-1.1	24,812	392,278	329,951
-1.8	0.004	1.6	1.064	0.213	-0.08	0.0633	33.6	33.5	0.9	-1.1	23,039	364,202	306,370
-1.3	-0.007	0.8	1.065	0.178	-0.08	0.0633	30.6	30.6	0.4	-0.7	21,059	332,709	280,042
-1.8	0.011	2.1	1.064	0.162	-0.10	0.0633	29.3	29.2	1.1	-0.9	20,109	317,578	267,401
-2.4	0.039	4.1	1.064	0.163	-0.10	0.0633	29.3	29.2	2.1	-1.2	20,100	317,475	267,291
-2.3	0.772	40.0	1.363	0.237	-0.21	0.0633	35.4	27.1	22.8	-1.1	18,647	294,467	247,959
-1.1	1.289	40.0	1.363	0.116	-0.16	0.0634	24.8	19.0	15.9	-0.4	13,050	205,984	173,537
-19.5	-270852.763	40.0	1.363	0.000	-0.05	0.0646	0.0	0.0	0.0	0.0	10	154	132
-3.1	-0.026	-0.6	1.066	0.236	-0.07	0.0633	35.4	35.3	-0.4	-1.9	24,260	383,368	322,606
-5.0	-0.018	0.0	1.065	0.264	-0.09	0.0633	37.4	37.2	0.0	-3.3	25,592	404,527	340,319
-3.7	-0.009	0.7	1.065	0.275	-0.13	0.0632	38.2	38.1	0.4	-2.5	26,170	413,792	348,003
-4.4	-0.055	-2.6	1.068	0.267	-0.50	0.0631	37.6	37.5	-1.7	-2.9	25,686	407,088	341,566
-5.7	-0.039	-1.5	1.066	0.206	-0.10	0.0632	33.1	32.9	-0.8	-3.3	22,584	357,117	300,318
-0.1	-0.033	-1.1	1.066	0.143	-0.05	0.0633	27.5	27.5	-0.5	0.0	18,904	298,685	251,377
0.7	0.015	2.4	1.064	0.131	-0.07	0.0633	26.3	26.3	1.1	0.3	18,061	285,247	240,167
-0.6	0.329	23.8	1.050	0.125	-0.07	0.0633	25.7	23.5	10.4	-0.3	16,176	255,504	215,109
0.1	0.241	18.4	1.062	0.114	-0.07	0.0633	24.5	23.2	7.7	0.0	15,983	252,421	212,543
-2.5	28.144	40.0	1.363	0.005	-0.09	0.0633	5.2	4.0	3.3	-0.2	2,728	43,086	36,277
-0.9	-0.401	-22.1	1.088	0.004	-0.11	0.0634	4.6	4.2	-1.7	-0.1	2,924	46,111	38,880
-6.0	0.103	8.8	1.066	0.279	-0.13	0.0632	38.4	37.8	5.8	-4.0	25,948	410,398	345,058
-6.5	-0.100	-5.7	1.073	0.285	-0.10	0.0632	38.8	38.4	-3.8	-4.4	26,353	416,686	350,438
-0.9	0.014	2.3	1.064	0.281	-0.09	0.0632	38.5	38.5	1.5	-0.6	26,449	418,203	351,714
-3.9	0.359	25.4	1.047	0.264	-0.09	0.0633	37.4	33.7	16.0	-2.3	23,153	365,893	307,890
-9.8	0.848	40.0	1.363	0.292	-0.23	0.0632	39.3	29.7	25.3	-5.1	20,370	322,091	270,882
-2.5	-0.040	-1.5	1.067	0.128	-0.08	0.0633	26.0	26.0	-0.7	-1.1	17,859	281,984	237,484
0.0	-0.052	-2.4	1.067	0.137	-0.08	0.0633	26.9	26.9	-1.1	0.0	18,479	291,801	245,733
0.5	-0.086	-4.7	1.071	0.101	-0.06	0.0633	23.1	23.0	-1.9	0.2	15,832	249,965	210,536
2.5	0.394	27.1	1.046	0.062	-0.06	0.0635	18.1	16.1	8.2	0.7	11,086	174,710	147,426
8.1	-0.736	-33.3	1.152	0.015	-0.11	0.0644	8.9	7.4	-4.9	1.0	5,152	80,011	68,506
-2.5	-0.771	-33.7	1.161	0.017	-0.13	0.0652	9.2	7.7	-5.1	-0.3	5,436	83,331	72,284

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Velocity Decay Determination

Location: FCCU Regenerator Vent
Test Run: 4
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Meter Operator: A. Christiansen
Probe Operator: I. Lopez
Test Date: 3/19/14
Start Time: 08:11
Stop Time: 08:42

Pitot C_p:
Static P:
Bar. Press. (in. Hg):
Moisture (%)[1]:
O_2 (dry volume %)[1]:
CO_2 (dry volume %)[1]:

Traverse Point	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	Unadjusted Velocity (calculated) ft/sec	Adjusted Velocity (calculated) ft/sec	
1-01		146		39.5	39.5	
1-02		146		34.7	34.7	
1-03		146		48.9	48.9	
1-04		146		48.5	48.5	
1-05		146		45.5	45.5	
1-06		145		33.5	27.5	Replacement Velocity
2-01		146		36.6	36.6	
2-02		145		42.6	42.6	
2-03		145		39.7	39.7	
2-04		145		37.3	37.3	
2-05		145		35.7	35.7	
2-06		145		25.2	20.4	Replacement Velocity
3-01		147		28.4	28.4	
3-02		146		33.8	33.8	
3-03		147		38.1	38.1	
3-04		147		35.9	35.9	
3-05		146		28.6	28.6	
3-06		146		18.8	17.6	Replacement Velocity
4-01		147		39.0	39.0	
4-02		147		40.2	40.2	
4-03		147		36.2	36.2	
4-04		147		31.3	31.3	
4-05		146		34.9	34.9	
4-06		146		11.2	14.4	Replacement Velocity
Final		146.1		35.2	34.8	

WAF - Calculated 0.9895
WAF - Actual 0.9895

Revision 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 4
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40255	
Port:	1	
Duct Side:	NA	

Pitot C_p: 0.000
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d1-06	1.0		145		5.3	2.63	4,778.36	4,656.63	121.74	320.51
d1-05	2.0		145		20.5	12.91	4,656.63	4,536.46	120.17	1,550.92
d1-04	3.0		145		33.5	27.04	4,536.46	4,417.86	118.60	3,207.26
d1-03	4.0		145		36.4	34.99	4,417.86	4,300.84	117.02	4,095.19
d1-02	5.0		145		37.0	36.71	4,300.84	4,185.39	115.45	4,238.76
d1-01	6.0		145		43.4	40.21	4,185.39	4,071.50	113.88	4,578.72
d_{rem}	6.0		145		43.4					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	17,991.35
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	43.43
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	3,888.66
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	21,880.02
b. 'Replacement velocity' for Port 1 (ft/sec.)	**27.47**

[1] Data obtained from Sample Train: 0
Test Run: 0

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 4
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40255	
Port:	2	
Duct Side:	NA	

Pitot C_p: 0.000
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d2-06	1.0		138		0.0	0.0	4,778.36	4,656.63	121.74	1
d2-05	2.0		144		14.6	7.3	4,656.63	4,536.46	120.17	880
d2-04	3.0		145		25.2	19.9	4,536.46	4,417.86	118.60	2,364
d2-03	4.0		145		27.4	26.3	4,417.86	4,300.84	117.02	3,083
d2-02	5.0		145		28.9	28.2	4,300.84	4,185.39	115.45	3,251
d2-01	6.0		145		34.2	31.5	4,185.39	4,071.50	113.88	3,592
d_{rem}	6.0		145		34.2					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	13,170.04
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	34.21
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	3,062.78
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	16,232.82
b. 'Replacement velocity' for Port 2 (ft/sec.)	**20.38**

[1] Data obtained from Sample Train: 0
Test Run: 0

Revision 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 4
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40255	
Port:	3	
Duct Side:	NA	

Pitot C_p: 0.000
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d3-06	1.0		141		7.8	3.9	4,778.36	4,656.63	121.74	475
d3-05	2.0		146		5.2	6.5	4,656.63	4,536.46	120.17	782
d3-04	3.0		146		18.8	12.0	4,536.46	4,417.86	118.60	1,426
d3-03	4.0		146		23.8	21.3	4,417.86	4,300.84	117.02	2,497
d3-02	5.0		146		23.7	23.8	4,300.84	4,185.39	115.45	2,747
d3-01	6.0		146		32.5	28.1	4,185.39	4,071.50	113.88	3,203
d_{rem}	6.0		146		32.5					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	11,130.21
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	32.51
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,910.75
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	14,040.96
b. 'Replacement velocity' for Port 3 (ft/sec.)	17.63

[1] Data obtained from Sample Train: 0
Test Run: 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 4
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40255	
Port:		
Duct Side:	NA	

Pitot C_p: 0.00
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d4-06	1.0		145		9.1	4.6	4,778.36	4,656.63	121.74	555
d4-05	2.0		146		6.0	7.6	4,656.63	4,536.46	120.17	908
d4-04	3.0		146		11.2	8.6	4,536.46	4,417.86	118.60	1,017
d4-03	4.0		146		15.5	13.3	4,417.86	4,300.84	117.02	1,562
d4-02	5.0		146		24.8	20.2	4,300.84	4,185.39	115.45	2,327
d4-01	6.0		146		25.2	25.0	4,185.39	4,071.50	113.88	2,847
d_{rem}	6.0		146		25.2					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	9,215.52
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	25.22
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,258.38
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	11,473.90
b. 'Replacement velocity' for Port (ft/sec.)	**14.41**

[1] Data obtained from Sample Train: 0
Test Run: 0

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Wednesday, 3/19/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	11
Dry Gas Molecular Weight [g/mol]:	30.2093333
Water Vapor Volume Fraction, Bws [-]:	0.22025191
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1806.4

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	854,289	237.3
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	13,746,763	229,113
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	11,979,889	199,665
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	9,341,295	155,688

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	0.0	48.9	28.8	28.8
Temperature [°F]:	137.5	146.9	145.5	145.9
Wet Gas Density [lbm/ft^3]:	0.0620	0.0628	0.0622	
Static Pressure [IWC]:	-1.65	0.11	-0.11	-0.09
Total Pressure [IWC]:	-1.65	0.28	0.09	0.16
Barometric Pressure [°Hg at 32°F]:	29.86	29.90	29.89	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 8:11 AM End Time: 8:51 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/19/14 08:08 AM	15	18.03	18.07

Probe Used	Generic_Uncalibrated
Rslo	0
Probe Calibration Date	3/11/2014

	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.017	-0.011	0.000	0.031	0.00	8:08 AM
POST	0.000	0.012	0.047	0.000	0.237	-1.83	8:52 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes e
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 8:11 AM End Time: 8:51 AM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.15	8:33 AM	3.02	29.90	0.259	0.051	0.016	0.27	146.2	-1.4
1	2	0.00	0.46	8:33 AM	3.02	29.90	0.199	0.119	0.009	0.28	146.3	-2.1
1	3	0.00	0.79	8:34 AM	3.02	29.90	0.393	-0.059	0.007	0.27	146.1	-0.2
1	4	0.00	1.13	8:34 AM	3.02	29.90	0.386	-0.097	0.006	0.25	145.9	-1.6
1	5	0.00	1.50	8:34 AM	3.02	29.90	0.341	-0.099	0.010	0.23	145.8	0.2
1	6	0.00	1.90	8:35 AM	3.02	29.90	0.312	-0.113	0.016	0.19	145.5	-1.4
1	7	0.00	2.34	8:35 AM	3.02	29.90	0.224	-0.037	-0.008	0.17	145.4	0.8
1	8	0.00	2.83	8:35 AM	3.02	29.90	0.217	-0.049	-0.011	0.15	145.4	0.1
1	9	0.00	3.40	8:35 AM	3.02	29.90	0.184	-0.077	-0.010	0.10	145.1	1.8
1	10	0.00	4.10	8:35 AM	3.02	29.90	0.072	-0.031	-0.098	0.00	144.7	1.7
1	11	0.00	5.12	8:36 AM	3.02	29.90	0.005	0.038	-0.290	0.00	144.6	1.1
2	1	90.00	0.15	8:39 AM	3.02	29.90	0.220	0.102	0.002	0.25	145.6	1.1
2	2	90.00	0.46	8:39 AM	3.02	29.90	0.306	-0.055	0.004	0.25	145.4	-9.3
2	3	90.00	0.79	8:40 AM	3.02	29.90	0.259	0.050	0.003	0.26	145.4	-2.2
2	4	90.00	1.13	8:40 AM	3.02	29.90	0.229	0.094	0.005	0.25	145.2	0.3
2	5	90.00	1.50	8:41 AM	3.02	29.90	0.211	0.062	0.008	0.24	145.1	-1.6
2	6	90.00	1.90	8:41 AM	3.02	29.90	0.204	-0.035	0.034	0.22	145.2	-5.3
2	7	90.00	2.34	8:41 AM	3.02	29.90	0.142	0.073	0.021	0.17	144.8	1.4
2	8	90.00	2.83	8:42 AM	3.02	29.90	0.152	0.052	-0.134	0.19	144.6	-1.2
2	9	90.00	3.40	8:42 AM	3.02	29.90	0.119	0.055	0.031	0.15	144.7	0.3
2	10	90.00	4.10	8:43 AM	3.02	29.90	0.037	0.017	0.069	0.05	144.4	-0.4
2	11	90.00	5.12	8:51 AM	3.02	29.90	0.000	0.075	0.068	-1.65	137.5	-0.5
3	1	180.00	0.15	8:11 AM	3.02	29.86	0.141	0.244	0.106	0.08	146.6	9.1
3	2	180.00	0.46	8:12 AM	3.02	29.86	0.237	0.037	0.086	0.07	146.5	0.1
3	3	180.00	0.79	8:15 AM	3.02	29.86	0.244	0.029	0.028	0.04	146.6	-2.7
3	4	180.00	1.13	8:15 AM	3.02	29.86	0.213	-0.025	-0.003	0.04	146.7	-6.9
3	5	180.00	1.50	8:16 AM	3.02	29.87	0.152	0.007	0.039	-0.01	146.5	-3.0
3	6	180.00	1.90	8:16 AM	3.02	29.87	0.186	-0.057	0.024	-0.02	146.4	-11.9
3	7	180.00	2.34	8:17 AM	3.02	29.87	0.125	0.052	0.056	-0.04	146.4	1.3
3	8	180.00	2.83	8:19 AM	3.02	29.89	0.100	0.084	0.019	0.00	146.3	4.1
3	9	180.00	3.40	8:19 AM	3.02	29.89	0.075	0.108	0.027	-0.02	146.1	9.2
3	10	180.00	4.10	8:19 AM	3.02	29.89	0.005	0.015	0.007	-0.12	146.3	3.4
3	11	180.00	5.12	8:20 AM	3.02	29.89	0.011	0.012	0.008	-0.10	140.9	-4.0
4	1	270.00	0.15	8:22 AM	3.02	29.90	0.264	-0.067	0.011	0.18	146.7	-13.3
4	2	270.00	0.46	8:23 AM	3.02	29.90	0.275	-0.049	0.008	0.20	146.9	-10.7
4	3	270.00	0.79	8:23 AM	3.02	29.90	0.217	0.046	0.011	0.20	146.8	-2.7
4	4	270.00	1.13	8:23 AM	3.02	29.90	0.161	0.101	0.005	0.19	146.9	-1.7
4	5	270.00	1.50	8:24 AM	3.02	29.90	0.200	0.014	-0.003	0.18	146.3	-3.3
4	6	270.00	1.90	8:24 AM	3.02	29.90	0.110	0.081	0.088	0.16	146.2	-7.0
4	7	270.00	2.34	8:25 AM	3.02	29.90	0.101	0.059	-0.003	0.15	146.1	-2.1
4	8	270.00	2.83	8:25 AM	3.02	29.90	0.041	0.085	0.007	0.14	146.2	-1.2
4	9	270.00	3.40	8:26 AM	3.02	29.90	0.027	0.086	0.011	0.14	146.1	-0.9
4	10	270.00	4.10	8:27 AM	3.02	29.90	0.006	0.025	0.037	0.02	145.6	-1.4
4	11	270.00	5.12	8:27 AM	3.02	29.90	0.014	0.020	0.010	0.03	145.3	-2.0

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 8:11 AM End Time: 8:51 AM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-1.4	0.064	5.9	1.065	0.294	-0.02	0.0621	39.8	39.5	4.1	-1.0	26,687	429,497	354,876
-2.1	0.043	4.4	1.064	0.226	0.06	0.0621	34.9	34.7	2.7	-1.2	23,449	377,363	311,818
-0.2	0.019	2.6	1.064	0.445	-0.18	0.0621	49.0	48.9	2.2	-0.2	33,015	531,503	439,032
-1.6	0.015	2.4	1.064	0.437	-0.19	0.0621	48.5	48.5	2.0	-1.4	32,696	526,204	434,782
0.2	0.028	3.3	1.064	0.386	-0.15	0.0622	45.6	45.5	2.7	0.2	30,742	494,626	408,806
-1.4	0.050	4.9	1.064	0.353	-0.16	0.0622	43.6	43.4	3.7	-1.1	29,331	471,663	390,044
0.8	-0.036	-1.3	1.066	0.254	-0.09	0.0622	37.0	37.0	-0.8	0.5	24,984	401,595	332,231
0.1	-0.051	-2.3	1.067	0.247	-0.09	0.0622	36.5	36.4	-1.5	0.1	24,624	395,827	327,448
1.8	-0.054	-2.6	1.068	0.210	-0.11	0.0622	33.6	33.5	-1.5	1.1	22,667	364,245	301,420
1.7	-1.364	40.0	1.363	0.134	-0.13	0.0623	26.8	20.5	17.2	0.6	13,897	223,142	184,795
1.1	-61.142	40.0	1.363	0.009	0.00	0.0623	6.9	5.3	4.4	0.1	3,562	57,184	47,371
1.1	0.009	1.9	1.064	0.249	0.00	0.0622	36.6	36.6	1.2	0.7	24,715	397,332	328,653
-9.3	0.012	2.1	1.064	0.346	-0.09	0.0622	43.2	42.6	1.6	-7.0	28,765	462,472	382,519
-2.2	0.013	2.2	1.064	0.293	-0.03	0.0622	39.7	39.7	1.6	-1.5	26,797	430,683	356,343
0.3	0.021	2.8	1.064	0.259	-0.01	0.0622	37.3	37.3	1.8	0.2	25,195	404,800	335,043
-1.6	0.039	4.1	1.064	0.239	0.00	0.0623	35.8	35.7	2.6	-1.0	24,147	387,909	321,110
-5.3	0.168	13.4	1.067	0.232	-0.01	0.0622	35.3	34.2	8.2	-3.2	23,122	371,491	307,477
1.4	0.148	12.0	1.067	0.162	0.00	0.0623	29.5	28.9	6.2	0.7	19,528	313,511	259,677
-1.2	-0.879	-32.7	1.140	0.198	-0.01	0.0623	32.6	27.4	-17.6	-0.6	18,571	298,077	246,950
0.3	0.261	19.7	1.060	0.134	0.01	0.0623	26.8	25.2	9.0	0.1	17,078	274,118	227,108
-0.4	1.876	40.0	1.363	0.068	-0.02	0.0623	19.1	14.6	12.3	-0.1	9,897	158,825	131,616
-0.5	1696836.085	40.0	1.363	0.000	-1.65	0.0628	0.0	0.0	0.0	0.0	10	166	138
9.1	0.751	40.0	1.363	0.262	-0.18	0.0620	37.6	28.4	24.2	4.6	19,135	308,733	254,460
0.1	0.364	25.6	1.047	0.260	-0.18	0.0620	37.4	33.8	16.2	0.1	22,728	366,660	302,239
-2.7	0.116	9.7	1.067	0.277	-0.23	0.0620	38.7	38.1	6.5	-1.8	25,643	413,820	341,000
-6.9	-0.015	0.2	1.065	0.242	-0.20	0.0620	36.2	35.9	0.1	-4.3	24,158	389,864	321,253
-3.0	0.259	19.6	1.060	0.171	-0.18	0.0620	30.4	28.6	10.2	-1.5	19,235	310,181	255,788
-11.9	0.128	10.6	1.067	0.212	-0.23	0.0620	33.8	32.5	6.2	-6.8	21,898	353,051	291,192
1.3	0.450	29.5	1.051	0.138	-0.17	0.0620	27.3	23.7	13.5	0.5	15,993	257,807	212,675
4.1	0.187	14.8	1.067	0.113	-0.11	0.0621	24.7	23.8	6.3	1.7	16,076	258,995	213,802
9.2	0.358	25.3	1.047	0.083	-0.10	0.0621	21.1	18.8	9.0	3.0	12,699	204,470	168,876
3.4	1.482	40.0	1.363	0.009	-0.13	0.0621	6.8	5.2	4.4	0.3	3,518	56,659	46,781
-4.0	0.752	40.0	1.363	0.020	-0.11	0.0626	10.2	7.8	6.6	-0.5	5,309	84,744	70,600
-13.3	0.043	4.4	1.064	0.299	-0.12	0.0621	40.2	39.0	3.1	-9.2	26,289	423,602	349,588
-10.7	0.030	3.4	1.064	0.311	-0.11	0.0620	41.0	40.2	2.5	-7.6	27,093	436,686	360,277
-2.7	0.049	4.8	1.064	0.245	-0.04	0.0621	36.4	36.2	3.1	-1.7	24,413	393,327	324,642
-1.7	0.029	3.4	1.064	0.182	0.01	0.0621	31.4	31.3	1.8	-0.9	21,096	339,873	280,533
-3.3	-0.016	0.2	1.065	0.227	-0.04	0.0621	35.0	34.9	0.1	-2.0	23,551	379,114	313,175
-7.0	0.802	40.0	1.363	0.204	-0.04	0.0621	33.2	25.2	21.3	-3.1	17,020	273,924	226,336
-2.1	-0.026	-0.5	1.066	0.114	0.03	0.0622	24.8	24.8	-0.2	-0.9	16,722	269,033	222,370
-1.2	0.162	13.0	1.067	0.047	0.10	0.0622	16.0	15.5	3.6	-0.3	10,491	168,778	139,505
-0.9	0.422	28.4	1.047	0.030	0.11	0.0622	12.7	11.2	6.0	-0.2	7,529	121,116	100,121
-1.4	6.084	40.0	1.363	0.011	0.01	0.0622	7.8	6.0	5.0	-0.1	4,049	65,101	53,843
-2.0	0.733	40.0	1.363	0.026	0.00	0.0622	11.9	9.1	7.7	-0.3	6,160	98,996	81,912

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Velocity Decay Determination

Location: FCCU Regenerator Vent
Test Run: 9
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Pitot C_p:
Static P:
Bar. Press. (in. Hg):
Moisture (%)[1]:
O_2 (dry volume %)[1]:
CO_2 (dry volume %)[1]:

Meter Operator: A. Christiansen
Probe Operator: I. Lopez
Test Date: 3/20/14
Start Time: 09:04
Stop Time: 09:22

Traverse Point	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	Unadjusted Velocity (calculated) ft/sec	Adjusted Velocity (calculated) ft/sec	
1-01		143		35.7	35.7	
1-02		135		35.6	35.6	
1-03		144		41.1	41.1	
1-04		143		38.8	38.8	
1-05		143		28.3	28.3	
1-06		143		19.1	15.6	Replacement Velocity
2-01		144		36.1	36.1	
2-02		144		35.9	35.9	
2-03		144		36.8	36.8	
2-04		144		35.4	35.4	
2-05		144		34.5	34.5	
2-06		143		27.6	19.2	Replacement Velocity
3-01		144		37.0	37.0	
3-02		144		34.6	34.6	
3-03		456		42.6	42.6	
3-04		146		34.7	34.7	
3-05		143		32.6	32.6	
3-06		143		24.7	16.0	Replacement Velocity
4-01		144		47.3	47.3	
4-02		144		36.9	36.9	
4-03		144		38.1	38.1	
4-04		144		37.1	37.1	
4-05		143		28.8	28.8	
4-06		143		27.0	19.1	Replacement Velocity
Final	1.0000	156.3		34.4	33.2	

WAF - Calculated 0.9654
WAF - Actual 0.9700

Revision 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 9
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40256	
Port:	1	
Duct Side:	NA	

Pitot C_p: 0.000
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E) Intermediate Calculations (in^2)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d1-06	1.0		132		4.3	2.14	4,778.36	4,656.63	121.74	260.22
d1-05	2.0		134		9.5	6.90	4,656.63	4,536.46	120.17	829.28
d1-04	3.0		143		14.6	12.08	4,536.46	4,417.86	118.60	1,432.34
d1-03	4.0		140		19.4	17.03	4,417.86	4,300.84	117.02	1,992.39
d1-02	5.0		143		24.4	21.91	4,300.84	4,185.39	115.45	2,529.72
d1-01	6.0		143		27.2	25.77	4,185.39	4,071.50	113.88	2,935.32
d_{rem}	6.0		143		27.2					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	9,979.27
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	27.15
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,430.92
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	12,410.19
b. 'Replacement velocity' for Port 1 (ft/sec.)	**15.58**

[1] Data obtained from Sample Train: 0
Test Run: 0

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 9
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Pitot C_p: 0.000
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40256	
Port:	2	
Duct Side:	NA	

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E) Intermediate Calculations (in^2)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d2-06	1.0		142		1.3	0.6	4,778.36	4,656.63	121.74	77
d2-05	2.0		143		9.5	5.4	4,656.63	4,536.46	120.17	647
d2-04	3.0		143		26.6	18.1	4,536.46	4,417.86	118.60	2,141
d2-03	4.0		143		26.1	26.3	4,417.86	4,300.84	117.02	3,083
d2-02	5.0		144		31.5	28.8	4,300.84	4,185.39	115.45	3,327
d2-01	6.0		144		29.0	30.3	4,185.39	4,071.50	113.88	3,450
d_{rem}	6.0		144		29.0					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	12,724.82
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	29.04
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,600.00
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	15,324.82
b. 'Replacement velocity' for Port 2 (ft/sec.)	**19.24**

[1] Data obtained from Sample Train: 0
Test Run: 0

Revision 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 9
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator: A. Christiansen 534
Probe Operator: I. Lopez 330
Test Date: 40256
Port: 3
Duct Side: NA

Pitot C_p: 0.000
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d3-06	1.0		142		2.1	1.1	4,778.36	4,656.63	121.74	130
d3-05	2.0		143		3.1	2.6	4,656.63	4,536.46	120.17	317
d3-04	3.0		143		23.8	13.5	4,536.46	4,417.86	118.60	1,597
d3-03	4.0		143		24.7	24.2	4,417.86	4,300.84	117.02	2,836
d3-02	5.0		143		26.7	25.7	4,300.84	4,185.39	115.45	2,968
d3-01	6.0		143		22.8	24.7	4,185.39	4,071.50	113.88	2,818
d_{rem}	6.0		143		22.8					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	10,666.85
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	22.76
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,037.40
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	12,704.25
b. 'Replacement velocity' for Port 3 (ft/sec.)	**15.95**

[1] Data obtained from Sample Train: 0
Test Run: 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 9
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Pitot C_p: 0.00
Static P: 0.0
Bar. Press. (in. Hg): 0.00
Moisture (%)[1]: 0.0
O_2 (dry volume %)[1]: 0.0
CO_2 (dry volume %)[1]: 0.0

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40256	
Port:		
Duct Side:	NA	

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d4-06	1.0		142		4.7	2.3	4,778.36	4,656.63	121.74	283
d4-05	2.0		143		10.4	7.5	4,656.63	4,536.46	120.17	904
d4-04	3.0		143		23.8	17.1	4,536.46	4,417.86	118.60	2,026
d4-03	4.0		143		27.6	25.7	4,417.86	4,300.84	117.02	3,003
d4-02	5.0		143		27.7	27.6	4,300.84	4,185.39	115.45	3,187
d4-01	6.0		143		28.9	28.3	4,185.39	4,071.50	113.88	3,220
d_{rem}	6.0		143		28.9					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	12,623.85
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	28.89
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,586.82
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. *Total volumetric flow* for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	15,210.67
b. 'Replacement velocity' for Port (ft/sec.)	**19.10**

[1] Data obtained from Sample Train: 0
Test Run: 0

Revision 0

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Thursday, 3/20/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	11
Dry Gas Molecular Weight [g/mol]:	30.906667
Water Vapor Volume Fraction, Bws [-]:	0.2175331
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1769.2

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	803,004	223.06
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	12,728,634	212,144
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	11,040,200	184,003
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	8,638,592	143,977

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	1.3	45.1	26.6	26.6
Temperature [°F]:	131.6	455.9	149.7	150.7
Wet Gas Density [lbm/ft^3]:	0.0421	0.0651	0.0634	
Static Pressure [IWC]:	-0.28	0.00	-0.08	-0.08
Total Pressure [IWC]:	-0.11	0.22	0.09	0.13
Barometric Pressure [\"Hg at 32°F]:	29.95	29.97	29.96	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 9:04 AM End Time: 9:23 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/20/14 08:11 AM	15	17.1	17.01

Probe Used	Generic Uncalibrated
Rsio	0
Probe Calibration Date	3/11/2014

	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (In IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.002	0.003	0.000	0.000	0.01	8:11 AM
POST	0.000	0.007	0.021	0.000	0.003	0.02	9:27 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 9:04 AM End Time: 9:23 AM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.15	9:04 AM	3.02	29.96	0.215	0.065	0.002	0.16	142.6	-1.6
1	2	0.00	0.46	9:04 AM	3.02	29.96	0.216	0.113	0.001	0.14	135.2	1.6
1	3	0.00	0.79	9:05 AM	3.02	29.96	0.284	-0.064	0.001	0.19	143.7	-9.7
1	4	0.00	1.13	9:05 AM	3.02	29.96	0.254	-0.042	0.000	0.22	143.5	-9.0
1	5	0.00	1.50	9:07 AM	3.02	29.96	0.135	0.016	0.003	0.11	143.2	-4.4
1	6	0.00	1.90	9:07 AM	3.02	29.96	0.125	0.030	0.003	0.11	143.2	-1.4
1	7	0.00	2.34	9:08 AM	3.02	29.96	0.102	0.028	0.009	0.05	143.0	-1.8
1	8	0.00	2.83	9:09 AM	3.02	29.96	0.084	0.007	0.033	0.04	140.4	-8.0
1	9	0.00	3.40	9:09 AM	3.02	29.96	0.038	0.007	0.033	-0.02	142.7	-3.6
1	10	0.00	4.10	9:10 AM	3.02	29.96	0.016	0.028	0.030	-0.08	134.2	-1.3
1	11	0.00	5.12	9:10 AM	3.02	29.96	0.003	0.023	0.000	-0.10	131.6	-1.5
2	1	90.00	0.15	9:11 AM	3.02	29.96	0.219	0.059	-0.002	0.14	143.8	-1.3
2	2	90.00	0.46	9:11 AM	3.02	29.96	0.217	0.057	-0.005	0.16	143.8	-1.8
2	3	90.00	0.79	9:12 AM	3.02	29.96	0.227	0.040	-0.006	0.21	143.9	-3.7
2	4	90.00	1.13	9:12 AM	3.02	29.96	0.210	0.060	-0.005	0.19	143.9	-1.8
2	5	90.00	1.50	9:12 AM	3.02	29.96	0.200	0.001	0.010	0.13	143.7	-6.4
2	6	90.00	1.90	9:12 AM	3.02	29.96	0.157	0.035	0.036	0.11	143.7	-3.3
2	7	90.00	2.34	9:12 AM	3.02	29.96	0.171	0.008	0.009	0.05	143.7	-6.2
2	8	90.00	2.83	9:13 AM	3.02	29.96	0.132	0.019	0.034	0.06	143.4	-6.4
2	9	90.00	3.40	9:13 AM	3.02	29.96	0.128	0.019	0.022	0.08	143.3	-6.5
2	10	90.00	4.10	9:14 AM	3.02	29.96	0.016	0.021	0.091	-0.10	143.2	-1.8
2	11	90.00	5.12	9:14 AM	3.02	29.96	0.000	0.023	0.013	-0.08	142.3	-2.8
3	1	180.00	0.15	9:17 AM	3.02	29.97	0.230	0.036	0.033	0.18	143.6	-2.9
3	2	180.00	0.46	9:17 AM	3.02	29.96	0.201	0.092	0.003	0.20	143.8	1.2
3	3	180.00	0.79	9:17 AM	3.02	29.96	0.202	0.088	0.003	0.21	455.9	1.4
3	4	180.00	1.13	9:18 AM	3.02	29.96	0.202	0.091	0.000	0.20	145.6	-0.2
3	5	180.00	1.50	9:18 AM	3.02	29.96	0.179	0.072	0.002	0.19	143.3	-0.9
3	6	180.00	1.90	9:18 AM	3.02	29.96	0.092	0.117	-0.029	0.11	143.3	4.0
3	7	180.00	2.34	9:18 AM	3.02	29.95	0.121	0.057	0.005	0.13	143.2	-0.2
3	8	180.00	2.83	9:18 AM	3.02	29.95	0.105	0.058	0.010	0.10	143.1	1.5
3	9	180.00	3.40	9:18 AM	3.02	29.95	0.103	0.051	0.021	0.08	143.1	1.8
3	10	180.00	4.10	9:19 AM	3.02	29.95	0.002	0.021	-0.032	-0.10	142.9	-1.5
3	11	180.00	5.12	9:19 AM	3.02	29.95	0.001	0.024	0.000	-0.07	141.9	-2.7
4	1	270.00	0.15	9:20 AM	3.02	29.96	0.375	-0.231	-0.008	0.15	143.8	-17.5
4	2	270.00	0.46	9:21 AM	3.02	29.96	0.228	0.026	-0.006	0.21	143.9	-4.3
4	3	270.00	0.79	9:21 AM	3.02	29.96	0.244	0.000	-0.005	0.21	143.8	-5.7
4	4	270.00	1.13	9:21 AM	3.02	29.96	0.231	-0.016	0.001	0.17	143.8	-6.3
4	5	270.00	1.50	9:21 AM	3.02	29.96	0.140	0.077	-0.003	0.06	143.4	0.4
4	6	270.00	1.90	9:21 AM	3.02	29.96	0.145	0.019	-0.034	0.05	143.3	-6.4
4	7	270.00	2.34	9:21 AM	3.02	29.96	0.134	0.028	0.017	0.09	143.1	-5.9
4	8	270.00	2.83	9:21 AM	3.02	29.96	0.135	0.013	0.100	0.07	143.2	-7.2
4	9	270.00	3.40	9:22 AM	3.02	29.96	0.127	0.005	0.050	0.01	143.2	-8.8
4	10	270.00	4.10	9:23 AM	3.02	29.96	0.019	0.039	0.079	-0.02	142.7	-9.6
4	11	270.00	5.12	9:23 AM	3.02	29.96	0.004	0.026	0.015	-0.11	142.0	-8.6

Project: 12412
Site: 12461 Marathon
Start Time: 9:04 AM End Time: 9:23 AM
Formatting Parameters

Traverse Data

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-1.6	0.009	1.9	1.064	0.243	-0.08	0.0639	35.7	35.7	1.2	-1.0	24,760	387,295	329,253
1.6	0.003	1.5	1.064	0.244	-0.10	0.0647	35.6	35.5	0.9	1.0	24,972	385,832	332,073
-9.7	0.004	1.6	1.064	0.321	-0.13	0.0638	41.1	40.5	1.1	-6.9	28,040	439,480	372,875
-9.0	0.000	1.3	1.064	0.287	-0.07	0.0638	38.8	38.3	0.9	-6.0	26,576	416,309	353,401
-4.4	0.019	2.7	1.064	0.153	-0.04	0.0639	28.3	28.2	1.3	-2.2	19,575	306,452	260,306
-1.4	0.022	2.9	1.064	0.141	-0.03	0.0639	27.2	27.2	1.4	-0.7	18,833	294,851	250,445
-1.8	0.084	7.4	1.065	0.116	-0.07	0.0639	24.6	24.4	3.2	-0.8	16,929	264,976	225,125
-8.0	0.385	26.7	1.046	0.092	-0.06	0.0642	21.9	19.4	9.9	-2.7	13,535	210,932	179,984
-3.6	0.880	40.0	1.363	0.070	-0.09	0.0639	19.1	14.6	12.3	-0.9	10,152	158,858	135,006
-1.3	1.884	40.0	1.363	0.030	-0.11	0.0648	12.4	9.5	8.0	-0.2	6,708	103,464	89,205
-1.5	0.008	1.9	1.064	0.004	-0.10	0.0651	4.3	4.3	0.1	-0.1	3,023	46,427	40,204
-1.3	-0.010	0.6	1.065	0.249	-0.11	0.0638	36.1	36.1	0.3	-0.8	25,020	392,181	332,719
-1.8	-0.022	-0.3	1.065	0.246	-0.08	0.0638	35.9	35.9	-0.2	-1.2	24,881	389,983	330,863
-3.7	-0.026	-0.6	1.066	0.258	-0.05	0.0638	36.8	36.7	-0.4	-2.4	25,415	398,381	337,962
-1.8	-0.025	-0.5	1.066	0.238	-0.05	0.0638	35.4	35.3	-0.3	-1.1	24,488	383,861	325,640
-6.4	0.049	4.9	1.064	0.227	-0.09	0.0638	34.5	34.1	2.9	-3.8	23,659	370,750	314,618
-3.3	0.227	17.5	1.064	0.177	-0.07	0.0638	30.5	29.0	9.2	-1.7	20,124	315,359	267,602
-6.2	0.053	5.1	1.064	0.193	-0.14	0.0638	31.9	31.5	2.8	-3.4	21,855	342,555	290,629
-6.4	0.258	19.5	1.060	0.148	-0.09	0.0638	27.9	26.1	9.3	-2.9	18,090	283,361	240,564
-6.5	0.176	14.0	1.067	0.145	-0.06	0.0639	27.6	26.6	6.7	-3.0	18,452	288,938	245,369
-1.8	5.769	40.0	1.363	0.029	-0.13	0.0639	12.4	9.5	8.0	-0.3	6,589	103,171	87,615
-2.8	44.968	40.0	1.363	0.001	-0.08	0.0640	1.7	1.3	1.1	-0.1	878	13,720	11,669
-2.9	0.142	11.6	1.067	0.262	-0.08	0.0638	37.0	36.2	7.5	-1.8	25,114	393,379	333,964
1.2	0.014	2.3	1.064	0.228	-0.03	0.0638	34.6	34.5	1.4	0.7	23,948	375,198	318,456
1.4	0.014	2.3	1.064	0.228	-0.02	0.0421	42.6	42.6	1.7	1.0	19,449	462,285	258,629
-0.2	-0.001	1.2	1.064	0.228	-0.03	0.0636	34.7	34.7	0.7	-0.1	23,947	376,361	318,445
-0.9	0.009	1.9	1.064	0.203	-0.01	0.0639	32.6	32.6	1.1	-0.5	22,623	354,249	300,839
4.0	-0.311	-17.9	1.089	0.110	0.00	0.0639	24.0	22.8	-7.4	1.6	15,782	247,120	209,872
-0.2	0.043	4.4	1.064	0.137	-0.01	0.0639	26.8	26.7	2.1	-0.1	18,548	290,387	246,649
1.5	0.099	8.5	1.066	0.119	-0.02	0.0639	25.0	24.7	3.7	0.6	17,113	267,920	227,572
1.8	0.200	15.7	1.066	0.117	-0.03	0.0639	24.7	23.8	6.7	0.8	16,506	258,416	219,501
-1.5	-18.398	40.0	1.363	0.003	-0.10	0.0639	4.1	3.1	2.6	-0.1	2,179	34,107	28,976
-2.7	0.209	16.3	1.065	0.001	-0.07	0.0640	2.2	2.1	0.6	-0.1	1,489	23,259	19,796
-17.5	-0.022	-0.3	1.065	0.426	-0.28	0.0638	47.3	45.1	-0.2	-14.2	31,224	489,602	415,215
-4.3	-0.025	-0.5	1.066	0.259	-0.05	0.0638	36.9	36.8	-0.3	-2.8	25,487	399,518	338,916
-5.7	-0.019	-0.1	1.065	0.276	-0.07	0.0638	38.1	37.9	-0.1	-3.8	26,255	411,531	349,142
-6.3	0.003	1.5	1.064	0.262	-0.09	0.0638	37.1	36.8	1.0	-4.0	25,517	399,935	339,320
0.4	-0.023	-0.4	1.065	0.159	-0.10	0.0638	28.8	28.8	-0.2	0.2	20,002	313,287	265,983
-6.4	-0.235	-14.0	1.087	0.171	-0.12	0.0639	30.0	28.9	-7.2	-3.2	20,034	313,760	266,416
-5.9	0.126	10.5	1.067	0.153	-0.06	0.0639	28.3	27.7	5.1	-2.8	19,185	300,343	255,117
-7.2	0.742	40.0	1.363	0.251	-0.18	0.0639	36.3	27.6	23.3	-3.5	19,109	299,253	254,107
-8.8	0.391	27.0	1.046	0.139	-0.13	0.0639	27.0	23.8	12.2	-3.7	16,489	258,191	219,263
-9.6	4.051	40.0	1.363	0.036	-0.05	0.0639	13.8	10.4	8.8	-1.8	7,214	112,856	95,936
-8.6	3.884	40.0	1.363	0.007	-0.12	0.0640	6.1	4.7	3.9	-0.7	3,234	50,543	43,010

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Velocity Decay Determination

Location: FCCU Regenerator Vent
Test Run: 13
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Meter Operator: A. Christiansen
Probe Operator: I. Lopez
Test Date: 3/21/14
Start Time: 07:53
Stop Time: 08:13

Pitot C_p:
Static P: 0.2
Bar. Press. (in. Hg): 30.18
Moisture (%)[1]: 0.20
O_2 (dry volume %)': 2.9
CO_2 (dry volume %)': 16.7

Traverse Point	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	Unadjusted Velocity (calculated) ft/sec	Adjusted Velocity (calculated) ft/sec	
1-01		146		37.7	37.7	
1-02		147		30.2	30.2	
1-03		145		34.2	34.2	
1-04		145		28.4	28.4	
1-05		146		28.7	28.7	
1-06		145		27.1	17.5	Replacement Velocity
2-01		145		39.8	39.8	
2-02		145		37.6	37.6	
2-03		145		33.8	33.8	
2-04		145		31.1	31.1	
2-05		145		42.2	42.2	
2-06		145		28.6	19.4	Replacement Velocity
3-01		148		37.0	37.0	
3-02		146		36.9	36.9	
3-03		146		34.6	34.6	
3-04		153		34.1	34.1	
3-05		145		41.8	41.8	
3-06		145		8.1	12.3	Replacement Velocity
4-01		145		35.9	35.9	
4-02		101		27.4	27.4	
4-03		145		37.1	37.1	
4-04		145		35.5	35.5	
4-05		145		35.2	35.2	
4-06		144		25.5	18.9	Replacement Velocity
Final	1.0000	144.0		32.9	32.0	

WAF - Calculated 0.9731
WAF - Actual 0.9731

Revision 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 13
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40257	
Port:	1	
Duct Side:	NA	

Pitot C_p: 1.000
Static P: 0.2
Bar. Press. (in. Hg): 30.18
Moisture (%)[1]: 0.2
O_2 (dry volume %)[1]: 2.9
CO_2 (dry volume %)[1]: 16.7

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.}$ H_2O)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E) Intermediate Calculations (in^2)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d1-06	1.0		143		6.9	3.47	4,778.36	4,656.63	121.74	422.25
d1-05	2.0		140		4.7	5.80	4,656.63	4,536.46	120.17	696.65
d1-04	3.0		145		25.4	15.01	4,536.46	4,417.86	118.60	1,780.20
d1-03	4.0		145		20.4	22.88	4,417.86	4,300.84	117.02	2,677.53
d1-02	5.0		145		21.5	20.95	4,300.84	4,185.39	115.45	2,418.19
d1-01	6.0		145		32.0	26.74	4,185.39	4,071.50	113.88	3,044.78
d_{rem}	6.0		145		32.0					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	11,039.61
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	31.98
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,863.20
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	13,902.81
b. 'Replacement velocity' for Port 1 (ft/sec.)	**17.46**

[1] Data obtained from Sample Train: 0
Test Run: 0

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 13
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Pitot C_p: 1.000
Static P: 0.2
Bar. Press. (in. Hg): 30.18
Moisture (%)[1]: 0.2
O_2 (dry volume %)[1]: 2.9
CO_2 (dry volume %)[1]: 16.7

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40257	
Port:	2	
Duct Side:	NA	

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d2-06	1.0		145		9.3	4.7	4,778.36	4,656.63	121.74	569
d2-05	2.0		145		11.1	10.2	4,656.63	4,536.46	120.17	1,230
d2-04	3.0		145		21.9	16.5	4,536.46	4,417.86	118.60	1,957
d2-03	4.0		145		27.8	24.9	4,417.86	4,300.84	117.02	2,908
d2-02	5.0		145		25.6	26.7	4,300.84	4,185.39	115.45	3,087
d2-01	6.0		145		29.0	27.3	4,185.39	4,071.50	113.88	3,113
d_{rem}	6.0		145		29.0					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	12,864.64
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	29.04
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,599.68
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	15,464.32
b. 'Replacement velocity' for Port 2 (ft/sec.)	**19.42**

[1] Data obtained from Sample Train: 0
Test Run: 0

Revision 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 13
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Pitot C_p: 1.000
Static P: 0.2
Bar. Press. (in. Hg): 30.18
Moisture (%)[1]: 0.2
O_2 (dry volume %)[1]: 2.9
CO_2 (dry volume %)[1]: 16.7

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40257	
Port:	3	
Duct Side:	NA	

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E) Intermediate Calculations (in^2)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d3-06	1.0		145		0.0	0.0	4,778.36	4,656.63	121.74	1
d3-05	2.0		145		0.0	0.0	4,656.63	4,536.46	120.17	2
d3-04	3.0		145		6.2	3.1	4,536.46	4,417.86	118.60	367
d3-03	4.0		145		23.5	14.8	4,417.86	4,300.84	117.02	1,737
d3-02	5.0		145		23.9	23.7	4,300.84	4,185.39	115.45	2,735
d3-01	6.0		145		24.5	24.2	4,185.39	4,071.50	113.88	2,753
d_{rem}	6.0		145		24.5					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	7,594.78
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	24.47
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,191.26
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. Total volumetric flow for Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	9,786.04
b. 'Replacement velocity' for Port 3 (ft/sec.)	**12.29**

[1] Data obtained from Sample Train: 0
Test Run: 0

Marathon Petroleum Co.
CleanAir Project No: 12461
FCCU Regenerator Vent

USEPA Method 2H - Replacement Velocity Determination

Location: FCCU Regenerator Vent
Test Run: 13
Client: Marathon Petroleum Co.
Project No: 12461

Diameter (in): 156.00
Radius (in): 78.00
Source Area (ft^2): 132.7323

Total M-1 Points: 24
M-1 Points per Dia.: 12

Meter Operator:	A. Christiansen	534
Probe Operator:	I. Lopez	330
Test Date:	40257	
Port:		
Duct Side:	NA	

Pitot C_p: 1.00
Static P: 0.2
Bar. Press. (in. Hg): 30.18
Moisture (%)[1]: 0.2
O_2 (dry volume %)[1]: 2.9
CO_2 (dry volume %)[1]: 16.7

Traverse Point	(A) Distance from Wall (in.)	Pitot ΔP_s (in. H_2O)	Stack T_s (°F)	$\sqrt{\Delta P_s}$ (calculated) ($\sqrt{in.\ H_2O}$)	(B) Velocity (calculated) (ft/sec)	(C) Decay Velocity (ft/sec)	(D) Intermediate Calculations (in^2)	(E)	(F) Area of Sub-sector (in^2)	(G) Volumetric Flow ($ft\text{-}in^2/sec$)
d4-06	1.0		143		0.0	0.0	4,778.36	4,656.63	121.74	1
d4-05	2.0		144		16.1	8.0	4,656.63	4,536.46	120.17	967
d4-04	3.0		144		24.7	20.4	4,536.46	4,417.86	118.60	2,419
d4-03	4.0		144		27.0	25.9	4,417.86	4,300.84	117.02	3,026
d4-02	5.0		145		28.9	28.0	4,300.84	4,185.39	115.45	3,228
d4-01	6.0		145		25.5	27.2	4,185.39	4,071.50	113.88	3,099
d_{rem}	6.0		145		25.5					

3. Total volumetric flow for all sub-sectors located between stack wall and d_{last}.	12,739.85
4. Volumetric flow for remainder of the Method 1 equal area sector.	
a. Velocity measurement at distance d_{rem}.	25.52
b. Total area in remainder of Method 1 equal-area segment. (A_{drem}) (in^2)	90
c. Total flow in remainder of Method 1 equal-area segment. (Q_{drem}) ($ft\text{-}in^2/sec$)	2,284.96
5. Wall effects-adjusted velocity in the Method 1 near-wall equal-area segment.	
a. *Total volumetric flow for* Method 1 equal-area sector closest to wall. (Q_t) ($ft\text{-}in_2/sec$)	15,024.81
b. 'Replacement velocity' for Port (ft/sec.)	**18.87**

[1] Data obtained from Sample Train: 0
Test Run: 0

Revision 0

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 1 Condition 1
Personnel:	A Christiansen
Date:	Friday, 3/21/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	11
Dry Gas Molecular Weight [g/mol]:	30.9133333
Water Vapor Volume Fraction, Bws [-]:	0.21912446
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1770.1

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	756,747	210.21
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	11,972,226	199,537
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	10,392,010	173,200
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	8,114,867	135,248

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	0.0	39.5	25.1	25.1
Temperature [°F]:	101.4	153.3	144.2	144.9
Wet Gas Density [lbm/ft^3]:	0.0572	0.0639	0.0632	
Static Pressure [IWC]:	-3.73	0.05	-0.90	-0.85
Total Pressure [IWC]:	-3.71	0.21	-0.74	-0.65
Barometric Pressure ["Hg at 32°F]:	25.01	29.89	29.77	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 7:53 AM End Time: 8:16 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/21/14 07:50 AM	15	18.99	19.03

Probe Used	Generic_Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.001	0.004	0.000	0.001	0.01	7:50 AM
POST	0.000	0.000	0.002	0.000	0.002	-0.21	8:17 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes e
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 7:53 AM End Time: 8:16 AM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.15	7:53 AM	3.02	29.88	0.237	-0.132	-0.009	0.17	146.3	-12.4
1	2	0.00	0.46	7:53 AM	3.02	29.88	0.152	0.105	-0.008	0.20	146.9	4.8
1	3	0.00	0.79	7:54 AM	3.02	29.88	0.195	0.073	-0.008	0.21	145.4	2.8
1	4	0.00	1.13	7:54 AM	3.02	29.88	0.134	0.060	-0.007	0.15	145.2	2.3
1	5	0.00	1.50	7:55 AM	3.02	29.88	0.137	0.131	-0.007	0.21	145.8	8.3
1	6	0.00	1.90	7:55 AM	3.02	29.88	0.171	0.040	-0.003	0.19	145.5	2.0
1	7	0.00	2.34	7:56 AM	3.02	29.88	0.084	0.053	0.016	0.11	145.0	6.3
1	8	0.00	2.83	7:56 AM	3.02	29.88	0.096	-0.001	0.046	0.12	145.1	-0.7
1	9	0.00	3.40	7:57 AM	3.02	29.88	0.124	-0.025	0.033	0.11	144.9	-3.8
1	10	0.00	4.10	7:57 AM	3.02	29.88	0.004	0.000	-0.002	-0.49	140.2	-2.2
1	11	0.00	5.12	7:59 AM	3.02	29.88	0.008	-0.007	0.016	-1.02	143.2	2.0
2	1	90.00	0.15	8:00 AM	3.02	29.88	0.264	-0.061	-0.010	-0.96	145.2	-7.4
2	2	90.00	0.46	8:00 AM	3.02	29.88	0.235	0.007	-0.009	-0.87	145.4	-2.6
2	3	90.00	0.79	8:00 AM	3.02	29.88	0.189	0.082	-0.012	-0.86	145.2	2.1
2	4	90.00	1.13	8:00 AM	3.02	29.88	0.160	0.127	-0.012	-0.92	145.1	6.0
2	5	90.00	1.50	8:01 AM	3.02	29.88	0.181	0.005	0.138	-1.27	145.1	-2.9
2	6	90.00	1.90	8:01 AM	3.02	29.88	0.163	0.018	0.112	-1.76	145.2	-1.2
2	7	90.00	2.34	8:01 AM	3.02	29.88	0.150	0.002	0.072	-2.49	145.2	-3.0
2	8	90.00	2.83	8:02 AM	3.02	29.88	0.131	0.037	0.011	-3.05	145.0	-0.1
2	9	90.00	3.40	8:02 AM	3.02	29.88	0.083	0.006	0.073	-3.54	144.9	0.5
2	10	90.00	4.10	8:02 AM	3.02	29.88	0.026	-0.017	0.009	-3.71	144.8	-0.4
2	11	90.00	5.12	8:03 AM	3.02	29.88	0.015	0.007	0.091	-3.65	145.1	0.1
3	1	180.00	0.15	8:06 AM	3.02	29.88	0.227	0.019	-0.007	-0.95	147.8	-1.6
3	2	180.00	0.46	8:06 AM	3.02	29.88	0.226	0.031	-0.005	-0.91	146.1	-1.5
3	3	180.00	0.79	8:06 AM	3.02	29.88	0.199	0.084	-0.006	-0.87	146.4	1.9
3	4	180.00	1.13	8:06 AM	3.02	29.88	0.191	0.084	-0.007	-0.83	153.3	1.1
3	5	180.00	1.50	8:07 AM	3.02	29.88	0.178	0.027	0.131	-0.72	145.1	-1.7
3	6	180.00	1.90	8:07 AM	3.02	29.88	0.136	0.042	0.063	-0.71	145.1	0.3
3	7	180.00	2.34	8:07 AM	3.02	29.88	0.125	0.047	0.049	-0.68	145.1	0.8
3	8	180.00	2.83	8:07 AM	3.02	29.88	0.108	0.038	-0.051	-0.69	145.0	0.6
3	9	180.00	3.40	8:09 AM	3.02	29.88	0.007	0.022	-0.157	-0.58	145.1	2.6
3	10	180.00	4.10	8:09 AM	3.02	29.88	0.000	-0.001	-0.051	-0.58	145.0	2.2
3	11	180.00	5.12	8:10 AM	3.02	29.88	0.000	0.014	-0.054	-0.56	144.6	4.1
4	1	270.00	0.15	8:12 AM	3.02	29.89	0.214	0.050	-0.012	-0.11	144.9	-0.1
4	2	270.00	0.46	8:13 AM	3.02	25.01	0.069	-1.184	-1.242	0.01	101.4	-38.1
4	3	270.00	0.79	8:14 AM	3.02	29.88	0.230	0.040	-0.011	-0.04	145.0	-1.1
4	4	270.00	1.13	8:14 AM	3.02	29.88	0.209	0.048	-0.015	-0.04	145.2	0.2
4	5	270.00	1.50	8:15 AM	3.02	29.88	0.207	0.063	-0.009	-0.02	145.2	0.5
4	6	270.00	1.90	8:15 AM	3.02	29.88	0.135	0.027	-0.080	-0.12	144.6	-1.3
4	7	270.00	2.34	8:15 AM	3.02	29.88	0.141	-0.003	0.004	-0.12	144.7	-4.4
4	8	270.00	2.83	8:15 AM	3.02	29.88	0.124	0.007	0.008	-0.15	144.5	-3.9
4	9	270.00	3.40	8:15 AM	3.02	29.88	0.109	0.010	0.019	-0.16	144.5	-3.4
4	10	270.00	4.10	8:16 AM	3.02	29.88	0.045	0.019	0.149	-0.19	144.1	-2.3
4	11	270.00	5.12	8:16 AM	3.02	29.88	0.000	0.005	0.000	-0.28	143.4	-1.2

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 7:53 AM End Time: 8:16 AM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-12.4	-0.038	-1.4	1.066	0.270	-0.10	0.0633	37.7	36.9	-0.9	-8.1	25,348	400,233	337,078
4.8	-0.053	-2.5	1.068	0.173	0.03	0.0633	30.2	30.1	-1.3	2.5	20,681	326,760	275,014
2.8	-0.039	-1.5	1.066	0.222	-0.01	0.0634	34.2	34.2	-0.9	1.7	23,560	371,313	313,293
2.3	-0.051	-2.3	1.067	0.153	0.00	0.0635	28.4	28.3	-1.1	1.1	19,517	307,520	259,535
8.3	-0.051	-2.4	1.067	0.156	0.05	0.0634	28.7	28.3	-1.2	4.1	19,517	307,790	259,534
2.0	-0.018	0.0	1.065	0.194	0.00	0.0634	32.0	32.0	0.0	1.1	22,031	347,283	292,969
6.3	0.191	15.1	1.066	0.095	0.02	0.0635	22.4	21.5	5.8	2.4	14,820	233,421	197,072
-0.7	0.484	30.9	1.059	0.107	0.01	0.0635	23.8	20.4	12.2	-0.2	14,061	221,504	186,977
-3.8	0.268	20.2	1.059	0.139	-0.03	0.0635	27.1	25.4	9.3	-1.7	17,488	275,448	232,549
-2.2	-0.390	-21.7	1.088	0.005	-0.49	0.0639	5.0	4.7	-1.9	-0.2	3,233	50,583	42,990
2.0	1.855	40.0	1.363	0.016	-1.03	0.0635	9.1	6.9	5.8	0.2	4,785	75,337	63,628
-7.4	-0.040	-1.5	1.066	0.300	-1.26	0.0633	39.8	39.5	-1.1	-5.1	27,139	428,907	360,887
-2.6	-0.039	-1.5	1.066	0.268	-1.13	0.0633	37.6	37.6	-1.0	-1.7	25,822	408,099	343,384
2.1	-0.063	-3.2	1.069	0.216	-1.08	0.0633	33.8	33.7	-1.9	1.2	23,160	365,843	307,984
6.0	-0.072	-3.8	1.069	0.183	-1.10	0.0633	31.1	30.9	-2.1	3.3	21,246	335,614	282,529
-2.9	0.763	40.0	1.363	0.337	-1.61	0.0632	42.2	32.3	27.1	-1.7	22,176	350,752	294,895
-1.2	0.688	38.4	1.263	0.259	-2.02	0.0632	37.1	29.0	23.1	-0.6	19,915	315,320	264,828
-3.0	0.480	30.7	1.057	0.168	-2.66	0.0631	29.9	25.6	15.2	-1.3	17,558	278,425	233,479
-0.1	0.085	7.4	1.065	0.148	-3.20	0.0630	28.1	27.8	3.6	0.0	19,040	302,289	253,192
0.5	0.891	40.0	1.363	0.153	-3.69	0.0629	28.6	21.9	18.4	0.2	14,945	237,513	198,740
-0.4	0.363	25.6	1.047	0.029	-3.73	0.0629	12.3	11.1	5.3	-0.1	7,606	120,862	101,146
0.1	6.023	40.0	1.363	0.028	-3.68	0.0629	12.2	9.3	7.8	0.0	6,387	101,529	84,938
-1.6	-0.031	-0.9	1.066	0.258	-1.21	0.0630	37.0	37.0	-0.6	-1.0	25,325	401,944	336,771
-1.5	-0.022	-0.3	1.065	0.256	-1.16	0.0632	36.9	36.8	-0.2	-1.0	25,284	400,072	336,220
1.9	-0.031	-0.9	1.066	0.226	-1.09	0.0632	34.6	34.6	-0.6	1.2	23,716	375,398	315,377
1.1	-0.038	-1.4	1.066	0.217	-1.05	0.0625	34.1	34.1	-0.8	0.6	23,148	370,569	307,826
-1.7	0.735	40.0	1.363	0.330	-1.05	0.0633	41.8	32.0	26.8	-1.0	21,993	347,335	292,454
0.3	0.463	30.0	1.053	0.151	-0.86	0.0633	28.3	24.5	14.2	0.1	16,835	265,783	223,870
0.8	0.397	27.2	1.046	0.136	-0.82	0.0634	26.9	23.9	12.3	0.4	16,428	259,312	218,455
0.6	-0.472	-25.1	1.087	0.127	-0.82	0.0634	25.9	23.5	-11.0	0.3	16,168	255,171	215,001
2.6	-23.545	40.0	1.363	0.012	-0.60	0.0634	8.1	6.2	5.2	0.3	4,256	67,137	56,594
2.2	-1266844.842	40.0	1.363	0.000	-0.58	0.0634	0.0	0.0	0.0	0.0	10	165	139
4.1	-1357418.371	40.0	1.363	0.000	-0.56	0.0634	0.0	0.0	0.0	0.0	10	165	139
-0.1	-0.057	-2.7	1.068	0.244	-0.35	0.0635	35.9	35.9	-1.7	-0.1	24,718	389,414	328,702
-38.1	-17.905	40.0	1.363	0.129	-0.12	0.0572	27.4	16.5	17.6	-13.0	10,287	179,711	136,799
-1.1	-0.047	-2.0	1.067	0.261	-0.30	0.0635	37.1	37.1	-1.3	-0.7	25,566	402,929	339,972
0.2	-0.070	-3.6	1.069	0.239	-0.28	0.0634	35.5	35.4	-2.3	0.2	24,417	384,930	324,688
0.5	-0.046	-2.0	1.067	0.235	-0.26	0.0634	35.2	35.2	-1.2	0.3	24,251	382,326	322,487
-1.3	-0.597	-29.6	1.103	0.164	-0.29	0.0635	29.4	25.5	-14.5	-0.6	17,596	277,147	233,988
-4.4	0.027	3.2	1.064	0.160	-0.28	0.0635	29.0	28.9	1.6	-2.2	19,927	313,905	264,986
-3.9	0.068	6.3	1.065	0.141	-0.29	0.0635	27.2	27.0	3.0	-1.8	18,627	293,332	247,700
-3.4	0.178	14.1	1.067	0.124	-0.28	0.0635	25.5	24.7	6.2	-1.5	17,041	268,354	226,613
-2.3	3.295	40.0	1.363	0.084	-0.28	0.0635	21.0	16.1	13.5	-0.6	11,097	174,621	147,560
-1.2	-5739.869	40.0	1.363	0.000	-0.28	0.0636	0.0	0.0	0.0	0.0	10	165	139

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 1 Condition 1
Personnel:	A Christiansen
Date:	Tuesday, 3/18/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	11
Dry Gas Molecular Weight [g/mol]:	30.88
Water Vapor Volume Fraction, Bws [-]:	0.2202285
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1772.7

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,000,550	277.93	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	15,814,450	263,574	257,723
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	13,764,075	229,401	224,309
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	10,732,833	178,881	174,915

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	16.1	38.5	33.1	33.1
Temperature [°F]:	141.8	144.7	143.5	143.6
Wet Gas Density [lbm/ft^3]:	0.0631	0.0635	0.0633	
Static Pressure [IWC]:	-0.50	-0.03	-0.11	-0.11
Total Pressure [IWC]:	-0.23	0.19	0.12	0.12
Barometric Pressure [°Hg at 32°F]:	29.75	29.76	29.76	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 10:10 AM End Time: 10:33 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/18/14 09:55 AM	15	15.61	15.66

Probe Used	Generic_Uncalibrated						
Rsto	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (In IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	-0.002	0.002	0.000	0.000	0.01	9:18 AM
POST	0.000	0.001	-0.010	0.000	0.001	0.02	10:35 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412
Site: 12461 Marathon
Start Time: 10:10 AM End Time: 10:33 AM
Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Wilhdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	10:32 AM	5.53	29.76	0.220	0.004	-0.003	0.14	143.4	-3.4
1	2	0.00	0.87	10:32 AM	5.53	29.76	0.166	0.104	-0.013	0.13	143.5	4.4
1	3	0.00	1.54	10:32 AM	5.53	29.76	0.199	0.066	-0.008	0.18	143.4	1.2
1	4	0.00	2.30	10:32 AM	5.53	29.76	0.151	0.117	-0.011	0.15	143.2	7.2
1	5	0.00	3.25	10:33 AM	5.53	29.76	0.167	0.023	-0.005	0.12	143.0	-0.2
1	9	0.00	4.62	10:33 AM	5.53	29.76	0.129	-0.039	0.014	0.07	142.9	-6.8
2	1	90.00	0.28	10:27 AM	5.53	29.76	0.221	0.011	-0.007	0.18	143.9	-1.7
2	2	90.00	0.87	10:27 AM	5.53	29.76	0.247	-0.036	-0.007	0.17	143.7	-5.2
2	3	90.00	1.54	10:28 AM	5.53	29.76	0.184	0.100	-0.007	0.16	143.8	2.5
2	4	90.00	2.30	10:28 AM	5.53	29.76	0.217	0.025	-0.005	0.16	143.8	-1.7
2	5	90.00	3.25	10:28 AM	5.53	29.76	0.188	0.012	0.001	0.14	143.7	-1.8
2	9	90.00	4.62	10:29 AM	5.53	29.76	0.128	0.008	0.099	0.03	142.9	-2.3
3	1	180.00	0.28	10:21 AM	5.53	29.76	0.208	0.023	-0.005	0.16	143.5	-3.1
3	2	180.00	0.87	10:22 AM	5.53	29.75	0.233	-0.006	-0.004	0.18	143.6	-5.0
3	3	180.00	1.54	10:22 AM	5.53	29.76	0.243	-0.001	-0.002	0.15	143.8	-3.7
3	4	180.00	2.30	10:22 AM	5.53	29.76	0.234	-0.005	-0.013	-0.23	144.7	-4.4
3	5	180.00	3.25	10:23 AM	5.53	29.76	0.182	-0.014	-0.007	0.11	143.8	-5.7
3	9	180.00	4.62	10:24 AM	5.53	29.75	0.101	0.028	0.024	0.05	143.1	0.1
4	1	270.00	0.28	10:10 AM	5.53	29.75	0.246	-0.009	0.025	0.15	143.9	-6.0
4	2	270.00	0.87	10:10 AM	5.53	29.75	0.247	-0.037	-0.025	0.19	143.8	-6.5
4	3	270.00	1.54	10:11 AM	5.53	29.75	0.248	0.031	0.003	0.19	143.8	-0.9
4	4	270.00	2.30	10:12 AM	5.53	29.76	0.241	-0.001	0.086	0.18	143.5	-3.9
4	5	270.00	3.25	10:13 AM	5.53	29.75	0.157	-0.036	0.133	0.06	143.4	-9.8
4	9	270.00	4.62	10:18 AM	5.53	29.76	0.057	0.008	0.022	0.01	141.8	2.5

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 10:10 AM End Time: 10:33 AM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-3.4	-0.015	0.2	1.065	0.249	-0.10	0.0633	36.3	36.2	0.1	-2.1	45,659	721,413	607,174
4.4	-0.078	-4.2	1.070	0.190	-0.06	0.0633	31.7	31.5	-2.3	2.4	39,747	628,037	528,550
1.2	-0.040	-1.6	1.067	0.226	-0.05	0.0633	34.6	34.6	-0.9	0.7	43,547	688,062	579,081
7.2	-0.073	-3.8	1.069	0.173	-0.03	0.0633	30.2	29.9	-2.0	3.8	37,714	595,624	501,512
-0.2	-0.028	-0.7	1.066	0.189	-0.07	0.0633	31.6	31.6	-0.4	-0.1	39,872	629,563	530,215
-6.8	0.109	9.2	1.066	0.147	-0.07	0.0634	27.8	27.3	4.5	-3.3	34,398	542,970	457,418
-1.7	-0.032	-1.0	1.066	0.251	-0.07	0.0632	36.5	36.4	-0.7	-1.1	45,879	725,384	610,099
-5.2	-0.030	-0.9	1.066	0.280	-0.11	0.0633	38.5	38.3	-0.6	-3.5	48,288	763,419	642,127
2.5	-0.035	-1.2	1.066	0.209	-0.05	0.0633	33.3	33.2	-0.7	1.4	41,862	661,812	556,674
-1.7	-0.024	-0.5	1.065	0.247	-0.09	0.0633	36.1	36.1	-0.3	-1.1	45,489	719,176	604,910
-1.8	0.004	1.6	1.064	0.213	-0.08	0.0633	33.6	33.5	0.9	-1.1	42,238	667,704	561,679
-2.3	0.772	40.0	1.363	0.237	-0.21	0.0633	35.4	27.1	22.8	-1.1	34,185	539,855	454,591
-3.1	-0.026	-0.6	1.066	0.236	-0.07	0.0633	35.4	35.3	-0.4	-1.9	44,477	702,842	591,444
-5.0	-0.018	0.0	1.065	0.264	-0.09	0.0633	37.4	37.2	0.0	-3.3	46,919	741,632	623,917
-3.7	-0.009	0.7	1.065	0.275	-0.13	0.0632	38.2	38.1	0.4	-2.5	47,978	758,619	638,005
-4.4	-0.055	-2.6	1.068	0.267	-0.50	0.0631	37.6	37.5	-1.7	-2.9	47,091	746,328	626,204
-5.7	-0.039	-1.5	1.066	0.206	-0.10	0.0632	33.1	32.9	-0.8	-3.3	41,404	654,714	550,582
0.1	0.241	18.4	1.062	0.114	-0.07	0.0633	24.5	23.2	7.7	0.0	29,303	462,771	389,662
-6.0	0.103	8.8	1.066	0.279	-0.13	0.0632	38.4	37.8	5.8	-4.0	47,572	752,396	632,607
-6.5	-0.100	-5.7	1.073	0.285	-0.10	0.0632	38.8	38.4	-3.8	-4.4	48,314	763,925	642,470
-0.9	0.014	2.3	1.064	0.281	-0.09	0.0632	38.5	38.5	1.5	-0.6	48,490	766,706	644,809
-3.9	0.359	25.4	1.047	0.264	-0.09	0.0633	37.4	33.7	16.0	-2.3	42,448	670,803	564,464
-9.8	0.848	40.0	1.363	0.292	-0.23	0.0633	39.3	29.7	25.2	-5.1	37,352	590,392	496,708
2.5	0.394	27.1	1.046	0.062	-0.06	0.0635	18.1	16.1	8.2	0.7	20,325	320,302	270,281

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Tuesday, 3/18/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.88
Water Vapor Volume Fraction, Bws [-]:	0.2202285
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1772.7

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,069,580	297.11	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	17,034,511	283,909	277,606
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	14,718,621	245,310	239,864
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	11,477,161	191,286	187,045

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	21.8	52.4	35.6	35.6
Temperature [°F]:	142.9	243.7	147.6	147.9
Wet Gas Density [lbm/ft^3]:	0.0542	0.0633	0.0629	
Static Pressure [IWC]:	-0.40	0.03	-0.11	-0.12
Total Pressure [IWC]:	0.02	0.22	0.16	0.17
Barometric Pressure [“Hg at 32°F]:	29.74	29.75	29.74	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 12:14 PM End Time: 12:46 PM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/18/14 12:42 PM	15	16.93	16.94

Probe Used	Generic_Uncalibrated
Rslo	0
Probe Calibration Date	3/11/2014

	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.000	-0.001	0.000	-0.001	-0.01	12:12 PM
POST	0.000	-0.003	0.002	0.000	0.001	-0.01	12:47 PM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 12:14 PM End Time: 12:46 PM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	12:14 PM	5.53	29.74	0.285	-0.007	0.020	0.18	243.7	-10.5
1	2	0.00	0.87	12:14 PM	5.53	29.74	0.285	-0.060	0.020	0.18	143.7	-7.5
1	3	0.00	1.54	12:14 PM	5.53	29.74	0.206	0.081	0.025	0.18	143.7	-1.0
1	4	0.00	2.30	12:14 PM	5.53	29.74	0.139	0.076	0.080	0.14	143.5	1.2
1	5	0.00	3.25	12:15 PM	5.53	29.74	0.142	-0.026	0.031	0.08	142.9	-4.9
1	6	0.00	4.62	12:15 PM	5.53	29.74	0.079	-0.001	0.000	0.03	142.9	-0.3
2	1	90.00	0.28	12:16 PM	5.53	29.74	0.277	-0.075	-0.145	0.22	143.6	-8.7
2	2	90.00	0.87	12:16 PM	5.53	29.74	0.267	-0.043	-0.100	0.22	143.8	-5.9
2	3	90.00	1.54	12:17 PM	5.53	29.75	0.277	-0.060	-0.126	0.20	143.7	-7.4
2	4	90.00	2.30	12:17 PM	5.53	29.74	0.276	-0.077	-0.123	0.19	143.6	-8.8
2	5	90.00	3.25	12:17 PM	5.53	29.74	0.221	-0.045	-0.085	0.18	143.6	-8.1
2	6	90.00	4.62	12:17 PM	5.53	29.74	0.218	-0.066	-0.084	0.16	143.6	-9.2
3	1	180.00	0.28	12:22 PM	5.53	29.74	0.253	-0.001	-0.003	0.19	143.7	-4.3
3	2	180.00	0.87	12:22 PM	5.53	29.74	0.436	-0.278	-0.001	0.19	143.6	-15.8
3	3	180.00	1.54	12:22 PM	5.53	29.74	0.513	-0.386	-0.006	0.18	143.7	-19.1
3	4	180.00	2.30	12:23 PM	5.53	29.74	0.197	0.073	0.001	0.14	143.6	1.6
3	5	180.00	3.25	12:23 PM	5.53	29.75	0.162	-0.022	0.003	0.02	143.1	-6.2
3	6	180.00	4.62	12:23 PM	5.53	29.75	0.231	-0.070	0.104	0.05	143.0	-2.9
4	1	270.00	0.28	12:30 PM	5.53	29.74	0.320	-0.097	0.002	0.19	143.1	-7.2
4	2	270.00	0.87	12:30 PM	5.53	29.74	0.251	0.009	-0.007	0.22	143.1	-4.5
4	3	270.00	1.54	12:43 PM	5.53	29.74	0.165	0.106	0.002	0.21	143.6	4.9
4	4	270.00	2.30	12:44 PM	5.53	29.74	0.205	0.007	0.000	0.19	143.5	-2.3
4	5	270.00	3.25	12:44 PM	5.53	29.74	0.159	-0.014	0.005	0.16	143.5	-5.7
4	6	270.00	4.62	12:46 PM	5.53	29.74	0.123	0.044	-0.005	0.15	143.5	0.0

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 12:14 PM End Time: 12:46 PM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-10.5	0.070	6.4	1.065	0.323	-0.14	0.0542	44.7	43.6	5.0	-8.1	47,125	868,887	626,661
-7.5	0.071	6.4	1.065	0.323	-0.15	0.0632	41.4	40.7	4.6	-5.3	51,291	811,254	682,068
-1.0	0.123	10.3	1.067	0.235	-0.05	0.0632	35.3	34.7	6.3	-0.6	43,689	690,843	580,965
1.2	0.570	33.8	1.098	0.168	-0.03	0.0633	29.8	24.8	16.6	0.5	31,215	493,417	415,088
-4.9	0.220	17.0	1.064	0.161	-0.08	0.0633	29.2	27.8	8.6	-2.4	35,067	553,898	466,319
-0.3	0.002	1.4	1.064	0.090	-0.06	0.0633	21.8	21.8	0.5	-0.1	27,465	433,807	365,231
-8.7	-0.522	-27.0	1.090	0.329	-0.10	0.0632	41.8	36.8	-19.0	-5.7	46,287	731,991	615,524
-5.9	-0.374	-20.9	1.088	0.316	-0.09	0.0632	40.9	38.0	-14.6	-3.9	47,824	756,390	635,956
-7.4	-0.454	-24.4	1.087	0.328	-0.12	0.0632	41.6	37.6	-17.2	-4.9	47,356	748,942	629,731
-8.8	-0.447	-24.1	1.087	0.326	-0.13	0.0632	41.5	37.5	-17.0	-5.8	47,172	746,014	627,292
-8.1	-0.387	-21.5	1.088	0.261	-0.08	0.0632	37.2	34.2	-13.6	-4.9	43,115	681,729	573,336
-9.2	-0.385	-21.4	1.088	0.258	-0.10	0.0632	37.0	34.0	-13.5	-5.5	42,770	676,369	568,752
-4.3	-0.010	0.5	1.065	0.287	-0.10	0.0632	39.0	38.9	0.4	-2.9	48,944	774,001	650,845
-15.8	-0.003	1.1	1.065	0.494	-0.30	0.0632	51.2	49.2	0.9	-13.9	61,928	979,837	823,510
-19.1	-0.011	0.5	1.065	0.581	-0.40	0.0632	55.5	52.4	0.4	-18.1	65,979	1,044,258	877,377
1.6	0.007	1.8	1.064	0.223	-0.08	0.0632	34.4	34.4	1.1	1.0	43,251	683,939	575,152
-6.2	0.019	2.7	1.064	0.183	-0.16	0.0633	31.1	30.9	1.5	-3.4	38,930	615,103	517,687
-2.9	0.448	29.5	1.050	0.255	-0.21	0.0633	36.7	31.9	18.1	-1.6	40,239	635,800	535,089
-7.2	0.005	1.7	1.064	0.363	-0.17	0.0633	43.8	43.4	1.3	-5.5	54,749	865,079	728,044
-4.5	-0.030	-0.8	1.066	0.285	-0.06	0.0633	38.8	38.7	-0.6	-3.0	48,789	770,743	648,791
4.9	0.012	2.1	1.064	0.187	0.03	0.0633	31.4	31.3	1.2	2.7	39,431	623,312	524,349
-2.3	-0.001	1.2	1.064	0.232	-0.04	0.0633	35.0	35.0	0.7	-1.4	44,072	696,656	586,065
-5.7	0.032	3.6	1.064	0.180	-0.02	0.0633	30.8	30.6	1.9	-3.0	38,575	609,800	512,965
0.0	-0.041	-1.6	1.067	0.140	0.01	0.0633	27.3	27.2	-0.8	0.0	34,317	542,439	456,338

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Tuesday, 3/18/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.88
Water Vapor Volume Fraction, Bws [-]:	0.2202285
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1772.7

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	971,421	269.84	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	15,383,376	256,390	250,698
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	13,362,436	222,707	217,763
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	10,419,646	173,661	169,811

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	19.9	41.4	32.2	32.2
Temperature [°F]:	143.5	144.5	144.2	144.2
Wet Gas Density [lbm/ft^3]:	0.0631	0.0632	0.0632	
Static Pressure [IWC]:	-0.17	0.01	-0.08	-0.08
Total Pressure [IWC]:	0.03	0.30	0.14	0.15
Barometric Pressure [*Hg at 32*F]:	29.72	29.73	29.73	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 7:08 PM End Time: 7:29 PM
Formatting Parameters
Velocities in fpm *False*
Insertion Depths from Near Wall *False*

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/18/14 12:42 PM	15	16.93	16.94

Probe Used	Generic_Uncalibrated						
RsIo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	-0.004	-0.022	0.000	-0.006	0.04	6:48 PM
POST	0.000	0.067	-0.100	0.000	-0.093	-0.01	7:32 PM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412
Site: 12461 Marathon
Start Time: 7:08 PM End Time: 7:29 PM
Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	7:25 PM	5.53	29.73	0.329	0.039	-0.259	0.30	144.3	-1.6
1	2	0.00	0.87	7:25 PM	5.53	29.73	0.263	-0.013	-0.065	0.24	144.4	-5.2
1	3	0.00	1.54	7:25 PM	5.53	29.73	0.252	-0.057	-0.008	0.24	144.3	-10.0
1	4	0.00	2.30	7:25 PM	5.53	29.73	0.206	0.035	-0.013	0.23	144.3	-2.2
1	5	0.00	3.25	7:25 PM	5.53	29.73	0.172	0.075	-0.017	0.18	144.3	1.8
1	6	0.00	4.62	7:26 PM	5.53	29.73	0.166	0.053	-0.031	0.19	144.3	0.8
2	1	90.00	0.28	7:27 PM	5.53	29.73	0.157	0.069	-0.012	0.15	144.0	3.2
2	2	90.00	0.87	7:27 PM	5.53	29.73	0.256	-0.086	-0.049	0.17	144.4	-8.4
2	3	90.00	1.54	7:28 PM	5.53	29.73	0.203	-0.021	-0.092	0.16	144.5	-6.8
2	4	90.00	2.30	7:28 PM	5.53	29.73	0.105	0.060	-0.092	0.14	144.2	4.7
2	5	90.00	3.25	7:29 PM	5.53	29.73	0.082	0.024	-0.054	0.08	144.1	-1.9
2	6	90.00	4.62	7:29 PM	5.53	29.73	0.152	-0.145	-0.086	0.10	143.8	-12.9
3	1	180.00	0.28	7:19 PM	5.53	29.73	0.200	0.050	-0.002	0.13	144.2	-0.6
3	2	180.00	0.87	7:19 PM	5.53	29.73	0.223	0.009	-0.003	0.13	144.4	-4.9
3	3	180.00	1.54	7:19 PM	5.53	29.73	0.292	-0.103	-0.003	0.16	144.2	-8.7
3	4	180.00	2.30	7:20 PM	5.53	29.73	0.222	-0.044	-0.005	0.10	144.3	-6.8
3	5	180.00	3.25	7:20 PM	5.53	29.73	0.114	0.064	0.003	0.06	144.3	-1.3
3	6	180.00	4.62	7:20 PM	5.53	29.73	0.145	-0.022	0.011	0.05	143.7	-6.0
4	1	270.00	0.28	7:22 PM	5.53	29.72	0.148	0.155	-0.005	0.15	143.7	4.7
4	2	270.00	0.87	7:08 PM	5.53	29.72	0.116	0.332	-0.002	0.14	144.4	9.4
4	3	270.00	1.54	7:09 PM	5.53	29.72	0.251	-0.035	0.000	0.15	144.4	-3.7
4	4	270.00	2.30	7:09 PM	5.53	29.72	0.209	-0.028	-0.002	0.13	144.3	-4.4
4	5	270.00	3.25	7:09 PM	5.53	29.72	0.126	0.013	-0.072	0.07	143.8	-3.4
4	6	270.00	4.62	7:10 PM	5.53	29.73	0.158	-0.057	0.087	0.03	143.5	-9.0

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 7:08 PM End Time: 7:29 PM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-1.6	-0.786	-33.8	1.164	0.446	-0.15	0.0631	48.6	40.4	-27.0	-1.1	50,763	804,127	675,040
-5.2	-0.248	-14.7	1.088	0.312	-0.08	0.0631	40.7	39.2	-10.3	-3.5	49,226	779,836	654,603
-10.0	-0.031	-0.9	1.066	0.286	-0.05	0.0631	38.9	38.3	-0.6	-6.7	48,197	763,346	640,917
-2.2	-0.064	-3.2	1.069	0.235	0.00	0.0631	35.3	35.2	-2.0	-1.4	44,290	701,403	588,965
1.8	-0.097	-5.5	1.072	0.198	-0.01	0.0632	32.4	32.2	-3.1	1.0	40,547	642,046	539,183
0.8	-0.186	-11.1	1.083	0.195	0.00	0.0631	32.2	31.6	-6.2	0.4	39,674	628,284	527,585
3.2	-0.077	-4.1	1.070	0.180	-0.03	0.0632	30.9	30.7	-2.2	1.7	38,683	612,222	514,400
-8.4	-0.192	-11.4	1.083	0.301	-0.13	0.0631	39.9	38.7	-7.9	-5.7	48,670	770,964	647,202
-6.8	-0.451	-24.3	1.087	0.240	-0.08	0.0631	35.7	32.3	-14.7	-3.9	40,597	643,124	539,849
4.7	-0.874	-32.8	1.143	0.138	0.00	0.0632	27.0	22.6	-14.6	1.9	28,456	450,525	378,407
-1.9	-0.666	-31.7	1.125	0.103	-0.02	0.0632	23.4	19.9	-12.3	-0.7	25,024	396,139	332,767
-12.9	-0.567	-28.6	1.096	0.183	-0.09	0.0632	31.1	26.6	-14.9	-6.1	33,506	530,176	445,555
-0.6	-0.009	0.6	1.065	0.226	-0.10	0.0631	34.6	34.6	0.4	-0.4	43,552	689,743	579,148
-4.9	-0.012	0.4	1.065	0.253	-0.12	0.0631	36.6	36.5	0.3	-3.1	45,893	727,031	610,281
-8.7	-0.011	0.5	1.065	0.331	-0.17	0.0631	41.9	41.4	0.4	-6.3	52,046	824,403	692,099
-6.8	-0.024	-0.4	1.065	0.252	-0.15	0.0631	36.6	36.3	-0.3	-4.3	45,654	723,180	607,103
-1.3	0.022	2.9	1.064	0.130	-0.07	0.0631	26.2	26.2	1.3	-0.6	32,900	521,038	437,496
-6.0	0.073	6.6	1.065	0.164	-0.11	0.0632	29.5	29.1	3.4	-3.1	36,642	579,781	487,259
4.7	-0.035	-1.2	1.066	0.169	-0.02	0.0632	29.9	29.8	-0.6	2.4	37,468	592,878	498,247
9.4	-0.020	-0.2	1.065	0.131	0.01	0.0631	26.4	26.0	-0.1	4.3	32,703	518,014	434,884
-3.7	0.000	1.3	1.064	0.284	-0.14	0.0631	38.8	38.7	0.9	-2.5	48,647	770,767	646,900
-4.4	-0.012	0.4	1.065	0.237	-0.11	0.0631	35.4	35.3	0.3	-2.7	44,403	703,444	590,469
-3.4	-0.571	-28.8	1.097	0.152	-0.08	0.0632	28.4	24.8	-13.7	-1.5	31,220	494,121	415,162
-9.0	0.552	33.2	1.086	0.186	-0.16	0.0632	31.4	26.0	17.2	-4.1	32,660	516,783	434,313

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Wednesday, 3/19/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	11
Dry Gas Molecular Weight [g/mol]:	30.209333
Water Vapor Volume Fraction, Bws [-]:	0.2202519
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1806.4

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,044,128	290.04	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	16,808,361	280,139	273,920
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	14,634,834	243,914	238,499
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	11,411,484	190,191	185,975

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	11.2	48.9	35.2	35.2
Temperature [°F]:	144.7	146.9	146.1	146.1
Wet Gas Density [lbm/ft^3]:	0.0620	0.0623	0.0621	
Static Pressure [IWC]:	-0.23	0.11	-0.08	-0.09
Total Pressure [IWC]:	-0.02	0.28	0.17	0.18
Barometric Pressure ["Hg at 32°F]:	29.86	29.90	29.89	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 8:11 AM End Time: 8:42 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/19/14 08:08 AM	15	18.03	18.07

Probe Used	Generic_Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (In IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.017	-0.011	0.000	0.031	0.00	8:08 AM
POST	0.000	0.012	0.047	0.000	0.237	-1.83	8:52 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 8:11 AM End Time: 8:42 AM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	8:33 AM	5.53	29.90	0.259	0.051	0.016	0.27	146.2	-1.4
1	2	0.00	0.87	8:33 AM	5.53	29.90	0.199	0.119	0.009	0.28	146.3	-2.1
1	3	0.00	1.54	8:34 AM	5.53	29.90	0.393	-0.059	0.007	0.27	146.1	-0.2
1	4	0.00	2.30	8:34 AM	5.53	29.90	0.386	-0.097	0.006	0.25	145.9	-1.6
1	5	0.00	3.25	8:34 AM	5.53	29.90	0.341	-0.099	0.010	0.23	145.8	0.2
1	9	0.00	4.62	8:35 AM	5.53	29.90	0.184	-0.077	-0.010	0.10	145.1	1.8
2	1	90.00	0.28	8:39 AM	5.53	29.90	0.220	0.102	0.002	0.25	145.6	1.1
2	2	90.00	0.87	8:39 AM	5.53	29.90	0.306	-0.055	0.004	0.25	145.4	-9.3
2	3	90.00	1.54	8:40 AM	5.53	29.90	0.259	0.050	0.003	0.26	145.4	-2.2
2	4	90.00	2.30	8:40 AM	5.53	29.90	0.229	0.094	0.005	0.25	145.2	0.3
2	5	90.00	3.25	8:41 AM	5.53	29.90	0.211	0.062	0.008	0.24	145.1	-1.6
2	9	90.00	4.62	8:42 AM	5.53	29.90	0.119	0.055	0.031	0.15	144.7	0.3
3	1	180.00	0.28	8:11 AM	5.53	29.86	0.141	0.244	0.106	0.08	146.6	9.1
3	2	180.00	0.87	8:12 AM	5.53	29.86	0.237	0.037	0.086	0.07	146.5	0.1
3	3	180.00	1.54	8:15 AM	5.53	29.86	0.244	0.029	0.028	0.04	146.6	-2.7
3	4	180.00	2.30	8:15 AM	5.53	29.86	0.213	-0.025	-0.003	0.04	146.7	-6.9
3	5	180.00	3.25	8:16 AM	5.53	29.87	0.152	0.007	0.039	-0.01	146.5	-3.0
3	9	180.00	4.62	8:19 AM	5.53	29.89	0.075	0.108	0.027	-0.02	146.1	9.2
4	1	270.00	0.28	8:22 AM	5.53	29.90	0.264	-0.067	0.011	0.18	146.7	-13.3
4	2	270.00	0.87	8:23 AM	5.53	29.90	0.275	-0.049	0.008	0.20	146.9	-10.7
4	3	270.00	1.54	8:23 AM	5.53	29.90	0.217	0.046	0.011	0.20	146.8	-2.7
4	4	270.00	2.30	8:23 AM	5.53	29.90	0.161	0.101	0.005	0.19	146.9	-1.7
4	5	270.00	3.25	8:24 AM	5.53	29.90	0.200	0.014	-0.003	0.18	146.3	-3.3
4	9	270.00	4.62	8:26 AM	5.53	29.90	0.027	0.086	0.011	0.14	146.1	-0.9

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 8:11 AM End Time: 8:42 AM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Flow [WACFH]	Flow [WSCFH]
-1.4	0.064	5.9	1.065	0.294	-0.02	0.0621	39.8	39.5	4.1	-1.0	48,926	787,411	650,607
-2.1	0.043	4.4	1.064	0.226	0.06	0.0621	34.9	34.7	2.7	-1.2	42,989	691,831	571,665
-0.2	0.019	2.6	1.064	0.445	-0.18	0.0621	49.0	48.9	2.2	-0.2	60,528	974,422	804,891
-1.6	0.015	2.4	1.064	0.437	-0.19	0.0621	48.5	48.5	2.0	-1.4	59,942	964,708	797,101
0.2	0.028	3.3	1.064	0.386	-0.15	0.0622	45.6	45.5	2.7	0.2	56,361	906,814	749,478
1.8	-0.054	-2.6	1.068	0.210	-0.11	0.0622	33.6	33.5	-1.5	1.1	41,556	667,782	552,604
1.1	0.009	1.9	1.064	0.249	0.00	0.0622	36.6	36.6	1.2	0.7	45,310	728,442	602,531
-9.3	0.012	2.1	1.064	0.346	-0.09	0.0622	43.2	42.6	1.6	-7.0	52,737	847,864	701,285
-2.2	0.013	2.2	1.064	0.293	-0.03	0.0622	39.7	39.7	1.6	-1.5	49,128	789,586	653,295
0.3	0.021	2.8	1.064	0.259	-0.01	0.0622	37.3	37.3	1.8	0.2	46,191	742,134	614,245
-1.6	0.039	4.1	1.064	0.239	0.00	0.0623	35.8	35.7	2.6	-1.0	44,270	711,167	588,701
0.3	0.261	19.7	1.060	0.134	0.01	0.0623	26.8	25.2	9.0	0.1	31,311	502,550	416,364
9.1	0.751	40.0	1.363	0.262	-0.18	0.0620	37.6	28.4	24.2	4.6	35,081	566,011	466,509
0.1	0.364	25.6	1.047	0.260	-0.18	0.0620	37.4	33.8	16.2	0.1	41,669	672,210	554,104
-2.7	0.116	9.7	1.067	0.277	-0.23	0.0620	38.7	38.1	6.5	-1.8	47,013	758,670	625,166
-6.9	-0.015	0.2	1.065	0.242	-0.20	0.0620	36.2	35.9	0.1	-4.3	44,290	714,751	588,964
-3.0	0.259	19.6	1.060	0.171	-0.18	0.0620	30.4	28.6	10.2	-1.5	35,265	568,665	468,945
9.2	0.358	25.3	1.047	0.083	-0.10	0.0621	21.1	18.8	9.0	3.0	23,282	374,862	309,606
-13.3	0.043	4.4	1.064	0.299	-0.12	0.0621	40.2	39.0	3.1	-9.2	48,197	776,603	640,912
-10.7	0.030	3.4	1.064	0.311	-0.11	0.0620	41.0	40.2	2.5	-7.6	49,670	800,590	660,508
-2.7	0.049	4.8	1.064	0.245	-0.04	0.0621	36.4	36.2	3.1	-1.7	44,757	721,100	595,178
-1.7	0.029	3.4	1.064	0.182	0.01	0.0621	31.4	31.3	1.8	-0.9	38,676	623,101	514,311
-3.3	-0.016	0.2	1.065	0.227	-0.04	0.0621	35.0	34.9	0.1	-2.0	43,176	695,041	574,153
-0.9	0.422	28.4	1.047	0.030	0.11	0.0622	12.7	11.2	6.0	-0.2	13,803	222,046	183,556

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	*Test 2 Condition 1*
Personnel:	A Christiansen
Date:	Wednesday, 3/19/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.209333
Water Vapor Volume Fraction, Bws [-]:	0.2202519
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1806.4

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,028,974	285.83	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	16,599,738	276,662	270,520
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	14,463,785	241,063	235,711
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	11,278,109	187,968	183,801

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	7.1	42.8	34.7	34.7
Temperature [°F]:	93.5	145.2	142.6	144.2
Wet Gas Density [lbm/ft^3]:	0.0615	0.0679	0.0622	
Static Pressure [IWC]:	-5.71	-1.05	-2.52	-2.56
Total Pressure [IWC]:	-5.53	-1.03	-2.26	-2.29
Barometric Pressure ["Hg at 32°F]:	29.92	29.92	29.92	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 10:09 AM End Time: 10:43 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/19/14 08:08 AM	15	18.03	18.07

Probe Used	Generic_Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (In IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.031	0.021	0.000	0.018	-4.14	10:04 AM
POST	0.000	0.030	0.019	0.000	-0.386	-1.17	10:41 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 10:09 AM End Time: 10:43 AM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time [Local]	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	10:09 AM	5.53	29.92	0.255	0.038	-0.116	-2.78	144.6	-1.4
1	2	0.00	0.87	10:09 AM	5.53	29.92	0.271	0.019	-0.105	-2.64	144.7	-3.7
1	3	0.00	1.54	10:09 AM	5.53	29.92	0.256	0.052	-0.095	-2.61	144.6	-2.5
1	4	0.00	2.30	10:09 AM	5.53	29.92	0.225	0.095	-0.090	-2.59	144.6	0.7
1	5	0.00	3.25	10:10 AM	5.53	29.92	0.204	0.054	-0.076	-2.60	144.5	-2.2
1	6	0.00	4.62	10:11 AM	5.53	29.92	0.183	0.018	0.100	-2.81	144.4	-4.2
2	1	90.00	0.28	10:14 AM	5.53	29.92	0.317	-0.103	0.080	-3.48	144.8	-12.7
2	2	90.00	0.87	10:43 AM	5.53	29.92	0.018	0.017	0.008	-1.03	93.5	-33.8
2	3	90.00	1.54	10:15 AM	5.53	29.92	0.304	-0.028	-0.105	-4.15	144.9	-6.5
2	4	90.00	2.30	10:15 AM	5.53	29.92	0.244	0.030	-0.080	-4.15	144.7	-2.7
2	5	90.00	3.25	10:16 AM	5.53	29.92	0.198	0.040	-0.092	-5.32	144.7	-1.2
2	6	90.00	4.62	10:16 AM	5.53	29.92	0.148	0.031	-0.037	-5.53	144.4	-2.1
3	1	180.00	0.28	10:31 AM	5.53	29.92	0.299	0.117	-0.041	-1.33	144.9	1.7
3	2	180.00	0.87	10:32 AM	5.53	29.92	0.274	0.011	0.021	-1.38	145.0	-3.8
3	3	180.00	1.54	10:32 AM	5.53	29.92	0.212	0.058	-0.087	-1.34	145.1	-6.7
3	4	180.00	2.30	10:33 AM	5.53	29.92	0.204	0.085	-0.074	-1.30	145.1	-5.6
3	5	180.00	3.25	10:33 AM	5.53	29.92	0.270	0.035	-0.077	-1.25	145.2	-4.9
3	6	180.00	4.62	10:34 AM	5.53	29.92	0.260	-0.028	-0.186	-1.32	145.2	-0.7
4	1	270.00	0.28	10:39 AM	5.53	29.92	0.244	0.009	0.008	-1.07	144.4	-4.6
4	2	270.00	0.87	10:37 AM	5.53	29.92	0.231	0.114	0.000	-1.14	144.8	1.6
4	3	270.00	1.54	10:37 AM	5.53	29.92	0.229	0.110	-0.002	-1.12	144.7	1.7
4	4	270.00	2.30	10:37 AM	5.53	29.92	0.202	0.156	-0.002	-1.11	144.5	2.3
4	5	270.00	3.25	10:39 AM	5.53	29.92	0.162	0.066	0.003	-1.13	144.2	0.9
4	6	270.00	4.62	10:39 AM	5.53	29.92	0.131	0.050	0.013	-1.17	143.7	-1.3

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 10:09 AM End Time: 10:43 AM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-1.4	-0.456	-24.4	1.087	0.301	-3.08	0.0619	40.3	36.7	-16.7	-0.9	45,241	731,153	601,606
-3.7	-0.387	-21.5	1.088	0.320	-2.96	0.0619	41.6	38.7	-15.3	-2.5	47,623	769,569	633,286
-2.5	-0.370	-20.8	1.089	0.303	-2.91	0.0619	40.5	37.8	-14.3	-1.7	46,599	752,754	619,663
0.7	-0.399	-22.1	1.088	0.266	-2.85	0.0619	37.9	35.2	-14.2	0.4	43,334	699,987	576,253
-2.2	-0.374	-20.9	1.088	0.241	-2.85	0.0619	36.1	33.7	-12.9	-1.3	41,569	671,277	552,784
-4.2	0.545	32.9	1.083	0.214	-3.02	0.0619	34.1	28.5	18.5	-2.1	35,126	567,481	467,104
-12.7	0.252	19.1	1.061	0.357	-3.84	0.0617	44.0	40.5	14.4	-9.1	49,816	806,902	662,442
-33.8	0.464	30.1	1.054	0.020	-1.05	0.0679	9.9	7.1	5.0	-4.8	9,607	141,439	127,752
-6.5	-0.347	-19.7	1.089	0.361	-4.51	0.0616	44.3	41.4	-14.9	-4.7	50,802	824,427	675,562
-2.7	-0.327	-18.8	1.089	0.290	-4.44	0.0617	39.7	37.5	-12.8	-1.8	46,057	747,050	612,464
-1.2	-0.463	-24.7	1.087	0.234	-5.55	0.0615	35.7	32.4	-15.0	-0.7	39,709	645,849	528,040
-2.1	-0.248	-14.6	1.088	0.175	-5.71	0.0615	30.9	29.9	-7.8	-1.1	36,567	594,704	486,267
1.7	-0.138	-8.1	1.077	0.347	-1.67	0.0620	43.3	42.8	-6.1	1.3	52,913	852,777	703,628
-3.8	0.077	6.9	1.065	0.311	-1.69	0.0620	40.9	40.6	4.9	-2.7	50,088	807,357	666,068
-6.7	-0.409	-22.5	1.088	0.251	-1.59	0.0620	36.8	33.8	-14.1	-4.0	41,704	672,211	554,573
-5.6	-0.364	-20.5	1.089	0.242	-1.54	0.0621	36.2	33.7	-12.7	-3.3	41,643	671,113	553,761
-4.9	-0.287	-16.7	1.089	0.320	-1.57	0.0620	41.6	39.7	-12.0	-3.4	48,981	789,574	651,338
-0.7	-0.714	-32.8	1.144	0.340	-1.66	0.0620	42.9	36.0	-23.2	-0.4	44,455	716,729	591,153
-4.6	0.031	3.5	1.064	0.276	-1.34	0.0622	38.6	38.4	2.4	-3.1	47,480	763,885	631,384
1.6	-0.002	1.2	1.064	0.262	-1.40	0.0621	37.6	37.5	0.8	1.1	46,416	747,414	617,239
1.7	-0.007	0.8	1.065	0.259	-1.38	0.0621	37.4	37.3	0.5	1.1	46,190	743,624	614,235
2.3	-0.009	0.6	1.065	0.229	-1.34	0.0621	35.2	35.1	0.4	1.4	43,458	699,294	577,904
0.9	0.018	2.5	1.064	0.184	-1.31	0.0622	31.5	31.4	1.4	0.5	38,906	625,689	517,369
-1.3	0.099	8.5	1.066	0.149	-1.32	0.0622	28.3	28.0	4.2	-0.6	34,689	557,480	461,295

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Wednesday, 3/19/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.209333
Water Vapor Volume Fraction, Bws [-]:	0.2202519
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1806.4

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,082,938	300.82	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	17,371,487	289,525	283,097
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	15,178,934	252,982	247,366
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	11,835,744	197,262	192,889

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	29.6	44.7	36.4	36.4
Temperature [°F]:	142.5	144.3	143.7	143.7
Wet Gas Density [lbm/ft^3]:	0.0623	0.0624	0.0623	
Static Pressure [IWC]:	-0.35	-0.09	-0.22	-0.22
Total Pressure [IWC]:	-0.04	0.22	0.05	0.06
Barometric Pressure [°Hg at 32°F]:	29.88	29.90	29.89	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 12:20 PM End Time: 1:00 PM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/19/14 08:08 AM	15	18.03	18.07

Probe Used	Generic_Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.033	0.016	0.000	0.004	-1.01	10:45 AM
POST	0.000	0.361	-0.042	0.000	0.285	0.38	1:02 PM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412
Site: 12461 Marathon

Start Time: 12:20 PM End Time: 1:00 PM
Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Palm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	12:58 PM	5.53	29.89	0.191	0.084	0.002	0.04	144.3	0.7
1	2	0.00	0.87	12:58 PM	5.53	29.89	0.166	0.086	-0.053	0.01	144.2	-3.5
1	3	0.00	1.54	12:59 PM	5.53	29.89	0.172	0.072	-0.016	0.05	144.1	-5.5
1	4	0.00	2.30	12:59 PM	5.53	29.88	0.263	0.013	-0.081	0.06	144.1	3.0
1	5	0.00	3.25	1:00 PM	5.53	29.89	0.218	-0.016	0.013	0.02	144.2	-1.9
1	6	0.00	4.62	1:00 PM	5.53	29.88	0.176	-0.056	-0.045	-0.04	142.5	-5.0
2	1	90.00	0.28	12:52 PM	5.53	29.89	0.199	0.081	0.102	0.13	143.4	-0.1
2	2	90.00	0.87	12:52 PM	5.53	29.89	0.211	0.084	-0.032	0.13	143.7	-0.4
2	3	90.00	1.54	12:53 PM	5.53	29.89	0.245	0.017	-0.010	0.15	143.5	-4.9
2	4	90.00	2.30	12:53 PM	5.53	29.89	0.220	0.066	-0.043	0.04	143.3	-1.1
2	5	90.00	3.25	12:54 PM	5.53	29.89	0.160	0.108	0.138	0.01	143.8	1.8
2	6	90.00	4.62	12:55 PM	5.53	29.89	0.163	0.051	-0.025	0.02	143.6	-5.0
3	1	180.00	0.28	12:40 PM	5.53	29.90	0.258	0.005	0.009	0.06	143.9	-5.3
3	2	180.00	0.87	12:41 PM	5.53	29.90	0.295	-0.075	0.005	0.08	143.9	-12.3
3	3	180.00	1.54	12:42 PM	5.53	29.90	0.260	0.050	0.019	0.07	143.6	-2.9
3	4	180.00	2.30	12:44 PM	5.53	29.89	0.327	0.121	-0.043	0.22	143.5	0.5
3	5	180.00	3.25	12:45 PM	5.53	29.89	0.295	0.025	0.033	0.12	143.6	-5.2
3	6	180.00	4.62	12:46 PM	5.53	29.90	0.249	-0.044	0.079	0.13	143.4	-4.8
4	1	270.00	0.28	12:20 PM	5.53	29.90	0.306	-0.030	-0.001	0.00	143.7	-7.9
4	2	270.00	0.87	12:20 PM	5.53	29.90	0.279	-0.007	-0.001	-0.01	144.2	-6.5
4	3	270.00	1.54	12:21 PM	5.53	29.90	0.296	-0.050	-0.003	0.01	144.0	-9.0
4	4	270.00	2.30	12:21 PM	5.53	29.90	0.165	0.100	-0.002	0.01	143.8	-4.6
4	5	270.00	3.25	12:21 PM	5.53	29.90	0.156	0.113	0.131	-0.04	143.7	2.0
4	6	270.00	4.62	12:23 PM	5.53	29.90	0.220	-0.003	-0.002	0.04	143.8	-6.4

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 12:20 PM End Time: 1:00 PM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
0.7	0.012	2.2	1.064	0.216	-0.18	0.0623	34.1	34.1	1.3	0.4	42,251	678,393	561,848
-3.5	-0.321	-18.4	1.089	0.196	-0.19	0.0623	32.5	30.8	-10.3	-1.9	38,151	612,489	507,322
-5.5	-0.092	-5.1	1.072	0.198	-0.15	0.0623	32.6	32.3	-2.9	-3.1	40,104	643,745	533,292
3.0	-0.307	-17.7	1.089	0.312	-0.25	0.0623	40.9	38.9	-12.5	2.0	48,274	775,184	641,945
-1.9	0.061	5.7	1.065	0.247	-0.23	0.0623	36.4	36.2	3.6	-1.2	44,920	721,213	597,340
-5.0	-0.255	-15.0	1.088	0.208	-0.25	0.0624	33.4	32.1	-8.7	-2.8	39,952	639,823	531,282
-0.1	0.511	31.8	1.068	0.226	-0.09	0.0624	34.9	29.6	18.4	0.0	36,796	589,760	489,305
-0.4	-0.150	-8.9	1.079	0.245	-0.11	0.0624	36.3	35.9	-5.6	-0.2	44,518	713,931	591,996
-4.9	-0.042	-1.7	1.067	0.279	-0.13	0.0624	38.7	38.6	-1.2	-3.3	47,884	767,753	636,762
-1.1	-0.196	-11.7	1.084	0.258	-0.22	0.0624	37.2	36.4	-7.5	-0.7	45,258	725,629	601,831
1.8	0.860	40.0	1.363	0.297	-0.28	0.0623	39.9	30.6	25.7	0.9	37,943	608,934	504,564
-5.0	-0.152	-9.0	1.079	0.190	-0.17	0.0624	31.9	31.4	-5.0	-2.7	38,977	625,073	518,305
-5.3	0.036	3.9	1.064	0.292	-0.23	0.0623	39.6	39.4	2.7	-3.7	48,845	783,635	649,530
-12.3	0.018	2.6	1.064	0.334	-0.25	0.0623	42.4	41.3	1.9	-9.0	51,299	823,141	682,161
-2.9	0.072	6.5	1.065	0.295	-0.22	0.0624	39.8	39.5	4.5	-2.0	48,996	785,748	651,549
0.5	-0.133	-7.8	1.077	0.379	-0.16	0.0624	45.1	44.7	-6.1	0.4	55,507	889,958	738,129
-5.2	0.111	9.4	1.066	0.336	-0.21	0.0624	42.4	41.7	6.9	-3.8	51,792	830,532	688,727
-4.8	0.319	23.2	1.052	0.275	-0.15	0.0624	38.4	35.2	15.1	-3.0	43,740	701,122	581,644
-7.9	-0.002	1.1	1.065	0.346	-0.35	0.0623	43.1	42.7	0.8	-6.0	53,007	850,286	704,879
-6.5	-0.002	1.1	1.064	0.316	-0.32	0.0623	41.2	40.9	0.8	-4.7	50,752	814,702	674,888
-9.0	-0.009	0.6	1.065	0.335	-0.32	0.0623	42.4	41.9	0.5	-6.6	51,996	834,327	691,435
-4.6	-0.014	0.3	1.065	0.187	-0.18	0.0624	31.7	31.6	0.2	-2.5	39,258	629,564	522,044
2.0	0.839	40.0	1.363	0.290	-0.33	0.0624	39.5	30.2	25.4	1.1	37,532	601,927	499,093
-6.4	-0.009	0.6	1.065	0.250	-0.21	0.0624	36.6	36.4	0.4	-4.1	45,187	724,617	600,895

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Wednesday, 3/19/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.209333
Water Vapor Volume Fraction, Bws [-]:	0.2202519
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1806.4

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,106,393	307.33	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	17,603,574	296,726	290,139
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	15,507,944	258,466	252,728
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	12,092,290	201,538	197,070

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	24.0	43.9	37.3	37.3
Temperature [°F]:	144.1	145.1	144.8	144.8
Wet Gas Density [lbm/ft^3]:	0.0621	0.0622	0.0621	
Static Pressure [IWC]:	-0.42	0.02	-0.12	-0.13
Total Pressure [IWC]:	0.00	0.25	0.16	0.16
Barometric Pressure [°Hg at 32°F]:	29.84	29.85	29.84	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 2:24 PM End Time: 2:56 PM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall *False*

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/19/14 08:08 AM	15	18.03	18.07

Probe Used	Generic_Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.244	-0.041	0.000	0.219	0.25	1:08 PM
POST	0.000	0.037	0.014	0.000	0.001	0.03	2:59 PM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412
Site: 12461 Marathon
Start Time: 2:24 PM End Time: 2:56 PM
Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Palm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	2:24 PM	5.53	29.85	0.325	-0.095	0.012	0.17	144.8	-8.6
1	2	0.00	0.87	2:25 PM	5.53	29.85	0.298	-0.035	0.007	0.16	145.0	-5.8
1	3	0.00	1.54	2:26 PM	5.53	29.85	0.303	-0.049	0.001	0.13	144.8	-7.6
1	4	0.00	2.30	2:26 PM	5.53	29.85	0.237	0.019	0.001	0.08	145.0	-2.7
1	5	0.00	3.25	2:30 PM	5.53	29.84	0.231	-0.080	0.080	0.00	144.1	-3.8
1	6	0.00	4.62	2:31 PM	5.53	29.85	0.248	-0.126	0.209	0.04	144.2	-7.8
2	1	90.00	0.28	2:33 PM	5.53	29.85	0.259	0.051	0.007	0.13	145.0	-1.3
2	2	90.00	0.87	2:34 PM	5.53	29.85	0.252	0.044	0.002	0.14	145.0	-1.3
2	3	90.00	1.54	2:35 PM	5.53	29.84	0.225	0.110	0.001	0.16	144.8	0.7
2	4	90.00	2.30	2:35 PM	5.53	29.85	0.227	0.079	-0.001	0.18	145.0	-0.5
2	5	90.00	3.25	2:36 PM	5.53	29.84	0.164	0.085	0.049	0.13	144.9	1.8
2	6	90.00	4.62	2:36 PM	5.53	29.85	0.165	0.054	0.010	0.05	144.8	-1.7
3	1	180.00	0.28	2:47 PM	5.53	29.84	0.299	-0.053	0.013	0.25	144.3	-6.2
3	2	180.00	0.87	2:48 PM	5.53	29.84	0.256	0.051	0.008	0.15	144.8	-2.1
3	3	180.00	1.54	2:50 PM	5.53	29.84	0.297	-0.069	0.005	0.22	144.8	-10.0
3	4	180.00	2.30	2:51 PM	5.53	29.84	0.253	0.061	0.008	0.23	144.9	-1.3
3	5	180.00	3.25	2:52 PM	5.53	29.84	0.195	0.024	0.007	0.21	145.0	-3.3
3	6	180.00	4.62	2:53 PM	5.53	29.84	0.197	-0.013	0.009	0.21	145.0	-7.1
4	1	270.00	0.28	2:54 PM	5.53	29.85	0.225	0.067	0.005	0.22	145.1	0.0
4	2	270.00	0.87	2:55 PM	5.53	29.84	0.296	-0.047	0.001	0.19	144.9	-7.9
4	3	270.00	1.54	2:55 PM	5.53	29.84	0.272	0.000	0.000	0.22	144.8	-4.4
4	4	270.00	2.30	2:55 PM	5.53	29.84	0.215	0.058	0.002	0.23	144.9	-2.5
4	5	270.00	3.25	2:56 PM	5.53	29.84	0.218	-0.027	0.123	0.17	144.8	-7.2
4	6	270.00	4.62	2:56 PM	5.53	29.84	0.102	0.061	0.020	0.13	144.2	2.7

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 2:24 PM End Time: 2:56 PM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-8.6	0.038	4.0	1.064	0.369	-0.20	0.0621	44.6	43.9	3.1	-6.7	54,370	874,919	723,006
-5.8	0.023	2.9	1.064	0.338	-0.18	0.0621	42.7	42.4	2.2	-4.3	52,430	843,975	697,210
-7.6	0.004	1.6	1.064	0.344	-0.22	0.0621	43.0	42.6	1.2	-5.7	52,744	848,874	701,380
-2.7	0.003	1.5	1.064	0.269	-0.19	0.0621	38.1	38.0	1.0	-1.8	46,992	756,529	624,895
-3.8	0.347	24.8	1.048	0.254	-0.25	0.0622	37.0	33.5	15.5	-2.2	41,498	667,190	551,835
-7.8	0.842	40.0	1.363	0.461	-0.42	0.0622	49.8	37.8	32.0	-5.2	46,802	752,863	622,365
-1.3	0.027	3.2	1.064	0.293	-0.16	0.0621	39.7	39.7	2.3	-0.9	49,050	789,534	652,261
-1.3	0.010	2.0	1.064	0.285	-0.15	0.0621	39.2	39.2	1.4	-0.9	48,440	779,697	644,151
0.7	0.005	1.6	1.064	0.255	-0.09	0.0621	37.0	37.0	1.1	0.4	45,808	737,147	609,145
-0.5	-0.003	1.1	1.065	0.257	-0.07	0.0621	37.2	37.2	0.7	-0.3	46,040	740,977	612,231
1.8	0.298	22.0	1.055	0.183	-0.05	0.0621	31.4	29.1	11.7	0.9	35,985	579,122	478,528
-1.7	0.059	5.6	1.065	0.187	-0.14	0.0621	31.7	31.6	3.1	-0.9	39,042	628,234	519,172
-6.2	0.043	4.4	1.064	0.339	-0.08	0.0622	42.7	42.3	3.3	-4.6	52,425	842,925	697,144
-2.1	0.033	3.6	1.064	0.290	-0.14	0.0621	39.5	39.4	2.5	-1.5	48,757	784,644	648,362
-10.0	0.018	2.6	1.064	0.336	-0.11	0.0621	42.5	41.9	1.9	-7.4	51,784	833,406	688,617
-1.3	0.034	3.7	1.064	0.287	-0.06	0.0621	39.3	39.2	2.5	-0.9	48,532	780,970	645,372
-3.3	0.038	4.1	1.064	0.221	-0.01	0.0621	34.5	34.4	2.4	-2.0	42,513	684,162	565,331
-7.1	0.045	4.6	1.064	0.223	-0.01	0.0621	34.7	34.3	2.8	-4.3	42,426	682,724	564,176
0.0	0.022	2.9	1.064	0.254	-0.04	0.0621	37.0	37.0	1.9	0.0	45,720	735,855	607,982
-7.9	0.004	1.6	1.064	0.335	-0.14	0.0621	42.5	42.1	1.2	-5.9	52,036	837,614	691,969
-4.4	0.000	1.3	1.064	0.308	-0.09	0.0621	40.7	40.6	0.9	-3.1	50,226	808,219	667,897
-2.5	0.008	1.9	1.064	0.243	-0.01	0.0622	36.2	36.2	1.2	-1.6	44,741	719,879	594,963
-7.2	0.564	33.6	1.094	0.261	-0.09	0.0621	37.5	31.0	20.7	-3.9	38,309	616,425	509,429
2.7	0.198	15.5	1.066	0.116	0.02	0.0622	24.9	24.0	6.7	1.1	29,723	477,689	395,251

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Wednesday, 3/19/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.209333
Water Vapor Volume Fraction, Bws [-]:	0.2202519
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1806.4

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	985,081	273.63	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	15,841,477	264,025	258,163
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	13,807,609	230,127	225,018
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	10,766,457	179,441	175,463

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	26.4	41.4	33.2	33.2
Temperature [°F]:	144.0	144.9	144.4	144.4
Wet Gas Density [lbm/ft^3]:	0.0621	0.0622	0.0622	
Static Pressure [IWC]:	-0.19	0.05	-0.06	-0.06
Total Pressure [IWC]:	0.01	0.27	0.16	0.17
Barometric Pressure [“Hg at 32°F]:	29.84	29.84	29.84	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 4:31 PM End Time: 5:01 PM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/19/14 04:40 PM	15	17.37	17.41

Probe Used	Generic_Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.036	0.013	0.000	0.143	0.04	4:30 PM
POST	0.000	0.002	0.000	0.000	-0.164	-0.10	5:02 PM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 4:31 PM End Time: 5:01 PM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	4:54 PM	5.53	29.84	0.217	0.017	-0.061	0.13	144.6	-1.8
1	2	0.00	0.87	4:54 PM	5.53	29.84	0.206	0.048	-0.076	0.13	144.9	-0.4
1	3	0.00	1.54	4:55 PM	5.53	29.84	0.236	-0.002	-0.080	0.12	144.9	-4.1
1	4	0.00	2.30	4:55 PM	5.53	29.84	0.213	0.040	-0.063	0.17	144.5	-1.3
1	5	0.00	3.25	4:56 PM	5.53	29.84	0.128	0.134	-0.044	0.08	144.2	8.1
1	6	0.00	4.62	4:56 PM	5.53	29.84	0.141	0.121	-0.052	0.09	144.3	8.3
2	1	90.00	0.28	4:57 PM	5.53	29.84	0.227	0.030	0.115	0.14	144.5	-1.2
2	2	90.00	0.87	4:57 PM	5.53	29.84	0.286	-0.034	-0.052	0.14	144.4	-6.8
2	3	90.00	1.54	4:57 PM	5.53	29.84	0.247	0.037	-0.101	0.14	144.4	-2.9
2	4	90.00	2.30	4:58 PM	5.53	29.84	0.233	-0.046	-0.095	0.08	144.6	-6.8
2	5	90.00	3.25	5:01 PM	5.53	29.84	0.128	0.072	0.001	0.04	144.3	4.7
2	6	90.00	4.62	5:01 PM	5.53	29.84	0.130	0.007	0.004	0.01	144.3	-0.9
3	1	180.00	0.28	4:34 PM	5.53	29.84	0.207	0.063	-0.004	0.27	144.3	0.6
3	2	180.00	0.87	4:34 PM	5.53	29.84	0.197	0.084	-0.005	0.27	144.3	2.0
3	3	180.00	1.54	4:34 PM	5.53	29.84	0.186	0.117	-0.006	0.23	144.2	3.6
3	4	180.00	2.30	4:35 PM	5.53	29.84	0.202	0.042	0.000	0.25	144.3	-1.5
3	5	180.00	3.25	4:35 PM	5.53	29.84	0.165	0.029	0.000	0.20	144.1	-2.4
3	6	180.00	4.62	4:38 PM	5.53	29.84	0.148	0.010	0.004	0.18	144.1	-5.9
4	1	270.00	0.28	4:32 PM	5.53	29.84	0.214	0.035	0.001	0.22	144.5	-4.4
4	2	270.00	0.87	4:31 PM	5.53	29.84	0.183	0.136	-0.004	0.24	144.7	0.0
4	3	270.00	1.54	4:32 PM	5.53	29.84	0.223	0.030	-0.001	0.23	144.3	-2.0
4	4	270.00	2.30	4:32 PM	5.53	29.84	0.237	-0.033	-0.003	0.24	144.2	-7.1
4	5	270.00	3.25	4:33 PM	5.53	29.84	0.156	0.024	-0.109	0.15	144.0	-3.6
4	6	270.00	4.62	4:33 PM	5.53	29.84	0.116	0.053	0.008	0.15	144.0	0.2

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 4:31 PM End Time: 5:01 PM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-1.8	-0.284	-16.6	1.089	0.257	-0.13	0.0621	37.2	35.6	-10.6	-1.1	44,097	709,570	586,403
-0.4	-0.368	-20.7	1.089	0.244	-0.11	0.0621	36.3	33.9	-12.8	-0.2	41,983	675,884	558,284
-4.1	-0.338	-19.2	1.089	0.280	-0.16	0.0621	38.9	36.6	-12.8	-2.6	45,277	728,936	602,092
-1.3	-0.298	-17.3	1.089	0.252	-0.09	0.0622	36.9	35.2	-10.9	-0.8	43,558	700,731	579,235
8.1	-0.340	-19.4	1.089	0.152	-0.07	0.0622	28.6	26.7	-9.5	3.8	33,109	532,327	440,276
8.3	-0.367	-20.6	1.089	0.167	-0.08	0.0622	30.0	27.8	-10.6	4.0	34,403	553,217	457,488
-1.2	0.508	31.7	1.067	0.258	-0.12	0.0622	37.3	31.7	19.6	-0.7	39,237	631,208	521,767
-6.8	-0.180	-10.8	1.082	0.335	-0.19	0.0622	42.5	41.4	-7.9	-5.0	51,246	824,472	681,466
-2.9	-0.407	-22.4	1.088	0.292	-0.16	0.0622	39.7	36.6	-15.1	-1.8	45,347	729,473	603,019
-6.8	-0.407	-22.4	1.088	0.276	-0.19	0.0621	38.5	35.4	-14.7	-4.2	43,763	704,287	581,956
4.7	0.009	1.9	1.064	0.145	-0.11	0.0622	28.0	27.8	0.9	2.3	34,476	554,377	458,453
-0.9	0.034	3.7	1.064	0.147	-0.14	0.0622	28.1	28.0	1.8	-0.4	34,707	558,159	461,524
0.6	-0.018	0.0	1.065	0.234	0.03	0.0622	35.5	35.5	0.0	0.4	43,979	706,901	584,828
2.0	-0.028	-0.7	1.066	0.224	0.05	0.0622	34.7	34.7	-0.4	1.2	42,947	690,253	571,100
3.6	-0.033	-1.0	1.066	0.211	0.02	0.0622	33.7	33.6	-0.6	2.1	41,685	669,917	554,319
-1.5	-0.002	1.1	1.064	0.229	0.02	0.0622	35.1	35.1	0.7	-0.9	43,423	698,040	577,432
-2.4	0.000	1.3	1.064	0.187	0.01	0.0622	31.7	31.7	0.7	-1.3	39,266	631,029	522,157
-5.9	0.025	3.1	1.064	0.168	0.02	0.0622	30.1	29.9	1.6	-3.1	37,003	594,687	492,067
-4.4	0.003	1.5	1.064	0.243	-0.03	0.0622	36.1	36.0	0.9	-2.7	44,601	717,285	593,100
0.0	-0.019	-0.1	1.065	0.208	0.03	0.0622	33.4	33.4	-0.1	0.0	41,386	665,694	550,350
-2.0	-0.005	0.9	1.065	0.253	-0.02	0.0622	36.9	36.9	0.6	-1.3	45,661	734,097	607,190
-7.1	-0.012	0.4	1.065	0.269	-0.02	0.0622	38.0	37.8	0.3	-4.7	46,763	751,700	621,854
-3.6	-0.698	-32.5	1.137	0.202	-0.05	0.0622	33.0	27.8	-17.7	-1.8	34,392	552,695	457,345
0.2	0.056	5.3	1.064	0.131	0.02	0.0622	26.6	26.4	2.5	0.1	32,771	526,536	435,783

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Thursday, 3/20/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	11
Dry Gas Molecular Weight [g/mol]:	30.906667
Water Vapor Volume Fraction, Bws [-]:	0.2175331
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1769.2

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,013,011	281.39	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	16,152,162	269,203	263,226
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	13,860,923	231,015	225,887
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	10,845,714	180,762	176,754

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	14.6	45.1	33.8	33.8
Temperature [°F]:	135.2	455.9	156.3	154.3
Wet Gas Density [lbm/ft^3]:	0.0421	0.0647	0.0630	
Static Pressure [IWC]:	-0.28	-0.01	-0.08	-0.08
Total Pressure [IWC]:	-0.02	0.22	0.15	0.16
Barometric Pressure [*Hg at 32°F]:	29.95	29.97	29.96	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 9:04 AM End Time: 9:22 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/20/14 08:11 AM	15	17.1	17.01

Probe Used	Generic Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.002	0.003	0.000	0.000	0.01	8:11 AM
POST	0.000	0.007	0.021	0.000	0.003	0.02	9:27 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412
Site: 12461 Marathon
Start Time: 9:04 AM End Time: 9:22 AM
Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	9:04 AM	5.53	29.96	0.215	0.065	0.002	0.16	142.6	-1.6
1	2	0.00	0.87	9:04 AM	5.53	29.96	0.216	0.113	0.001	0.14	135.2	1.6
1	3	0.00	1.54	9:05 AM	5.53	29.96	0.284	-0.064	0.001	0.19	143.7	-9.7
1	4	0.00	2.30	9:05 AM	5.53	29.96	0.254	-0.042	0.000	0.22	143.5	-9.0
1	5	0.00	3.25	9:07 AM	5.53	29.96	0.135	0.016	0.003	0.11	143.2	-4.4
1	9	0.00	4.62	9:09 AM	5.53	29.96	0.038	0.007	0.033	-0.02	142.7	-3.6
2	1	90.00	0.28	9:11 AM	5.53	29.96	0.219	0.059	-0.002	0.14	143.8	-1.3
2	2	90.00	0.87	9:11 AM	5.53	29.96	0.217	0.057	-0.005	0.16	143.8	-1.8
2	3	90.00	1.54	9:12 AM	5.53	29.96	0.227	0.040	-0.006	0.21	143.9	-3.7
2	4	90.00	2.30	9:12 AM	5.53	29.96	0.210	0.060	-0.005	0.19	143.9	-1.8
2	5	90.00	3.25	9:12 AM	5.53	29.96	0.200	0.001	0.010	0.13	143.7	-6.4
2	9	90.00	4.62	9:13 AM	5.53	29.96	0.128	0.019	0.022	0.08	143.3	-6.5
3	1	180.00	0.28	9:17 AM	5.53	29.97	0.230	0.036	0.033	0.18	143.6	-2.9
3	2	180.00	0.87	9:17 AM	5.53	29.96	0.201	0.092	0.003	0.20	143.8	1.2
3	3	180.00	1.54	9:17 AM	5.53	29.96	0.202	0.088	0.003	0.21	455.9	1.4
3	4	180.00	2.30	9:18 AM	5.53	29.96	0.202	0.091	0.000	0.20	145.6	-0.2
3	5	180.00	3.25	9:18 AM	5.53	29.96	0.179	0.072	0.002	0.19	143.3	-0.9
3	9	180.00	4.62	9:18 AM	5.53	29.95	0.103	0.051	0.021	0.08	143.1	1.8
4	1	270.00	0.28	9:20 AM	5.53	29.96	0.375	-0.231	-0.008	0.15	143.8	-17.5
4	2	270.00	0.87	9:21 AM	5.53	29.96	0.228	0.026	-0.006	0.21	143.9	-4.3
4	3	270.00	1.54	9:21 AM	5.53	29.96	0.244	0.000	-0.005	0.21	143.8	-5.7
4	4	270.00	2.30	9:21 AM	5.53	29.96	0.231	-0.016	0.001	0.17	143.8	-6.3
4	5	270.00	3.25	9:21 AM	5.53	29.96	0.140	0.077	-0.003	0.06	143.4	0.4
4	9	270.00	4.62	9:22 AM	5.53	29.96	0.127	0.005	0.050	0.01	143.2	-8.8

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 9:04 AM End Time: 9:22 AM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Flow [WACFH]	Flow [WSCFH]
-1.6	0.009	1.9	1.064	0.243	-0.08	0.0639	35.7	35.7	1.2	-1.0	45,393	710,041	603,630
1.6	0.003	1.5	1.064	0.244	-0.10	0.0647	35.6	35.5	0.9	1.0	45,782	707,359	608,801
-9.7	0.004	1.6	1.064	0.321	-0.13	0.0638	41.1	40.5	1.1	-6.9	51,407	805,713	683,604
-9.0	0.000	1.3	1.064	0.287	-0.07	0.0638	38.8	38.3	0.9	-6.0	48,722	763,232	647,901
-4.4	0.019	2.7	1.064	0.153	-0.04	0.0639	28.3	28.2	1.3	-2.2	35,888	561,829	477,228
-3.6	0.880	40.0	1.363	0.070	-0.09	0.0639	19.1	14.6	12.3	-0.9	18,613	291,240	247,510
-1.3	-0.010	0.6	1.065	0.249	-0.11	0.0638	36.1	36.1	0.3	-0.8	45,871	718,998	609,984
-1.8	-0.022	-0.3	1.065	0.246	-0.08	0.0638	35.9	35.9	-0.2	-1.2	45,615	714,969	606,581
-3.7	-0.026	-0.6	1.066	0.258	-0.05	0.0638	36.8	36.7	-0.4	-2.4	46,594	730,364	619,597
-1.8	-0.025	-0.5	1.066	0.238	-0.05	0.0638	35.4	35.3	-0.3	-1.1	44,895	703,745	597,007
-6.4	0.049	4.9	1.064	0.227	-0.09	0.0638	34.5	34.1	2.9	-3.8	43,375	679,708	576,800
-6.5	0.176	14.0	1.067	0.145	-0.06	0.0639	27.6	26.6	6.7	-3.0	33,828	529,719	449,844
-2.9	0.142	11.6	1.067	0.262	-0.08	0.0638	37.0	36.2	7.5	-1.8	46,043	721,195	612,267
1.2	0.014	2.3	1.064	0.228	-0.03	0.0638	34.6	34.5	1.4	0.7	43,904	687,863	583,836
1.4	0.014	2.3	1.064	0.228	-0.02	0.0421	42.6	42.6	1.7	1.0	35,656	847,522	474,153
-0.2	-0.001	1.2	1.064	0.228	-0.03	0.0636	34.7	34.7	0.7	-0.1	43,903	689,995	583,816
-0.9	0.009	1.9	1.064	0.203	-0.01	0.0639	32.6	32.6	1.1	-0.5	41,476	649,457	551,538
1.8	0.200	15.7	1.066	0.117	-0.03	0.0639	24.7	23.8	6.7	0.8	30,262	473,763	402,419
-17.5	-0.022	-0.3	1.065	0.426	-0.28	0.0638	47.3	45.1	-0.2	-14.2	57,244	897,604	761,227
-4.3	-0.025	-0.5	1.066	0.259	-0.05	0.0638	36.9	36.8	-0.3	-2.8	46,725	732,450	621,347
-5.7	-0.019	-0.1	1.065	0.276	-0.07	0.0638	38.1	37.9	-0.1	-3.8	48,135	754,474	640,093
-6.3	0.003	1.5	1.064	0.262	-0.09	0.0638	37.1	36.8	1.0	-4.0	46,781	733,214	622,087
0.4	-0.023	-0.4	1.065	0.159	-0.10	0.0638	28.8	28.8	-0.2	0.2	36,670	574,360	487,635
-8.8	0.391	27.0	1.046	0.139	-0.13	0.0639	27.0	23.8	12.2	-3.7	30,229	473,350	401,982

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA. Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Thursday, 3/20/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.906667
Water Vapor Volume Fraction, Bws [-]:	0.2175331
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1769.2

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	988,981	274.72	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	15,587,463	259,791	254,024
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	13,574,544	226,242	221,220
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	10,621,632	177,027	173,102

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	23.4	39.9	32.6	32.6
Temperature [°F]:	142.7	201.7	147.2	147.2
Wet Gas Density [lbm/ft^3]:	0.0582	0.0639	0.0635	
Static Pressure [IWC]:	-0.40	0.02	-0.07	-0.08
Total Pressure [IWC]:	-0.20	0.22	0.13	0.14
Barometric Pressure [*Hg at 32°F]:	29.95	29.96	29.96	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 11:40 AM End Time: 11:48 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/20/14 08:11 AM	15	17.1	17.01

Probe Used	Generic_Uncalibrated
Rslo	0
Probe Calibration Date	3/11/2014

	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.015	0.029	0.000	0.003	-0.04	11:39 AM
POST	0.000	0.016	0.030	0.000	-0.043	-0.30	11:48 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 11:40 AM End Time: 11:48 AM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	11:40 AM	5.53	29.96	0.161	0.135	-0.006	0.17	142.7	2.4
1	2	0.00	0.87	11:40 AM	5.53	29.96	0.217	0.066	-0.009	0.16	143.1	-2.0
1	3	0.00	1.54	11:40 AM	5.53	29.96	0.276	-0.056	-0.006	0.14	143.6	-10.2
1	4	0.00	2.30	11:40 AM	5.53	29.96	0.191	0.100	0.003	0.12	201.7	-0.3
1	5	0.00	3.25	11:40 AM	5.53	29.96	0.161	0.043	-0.021	0.11	171.1	-3.3
1	6	0.00	4.62	11:41 AM	5.53	29.96	0.129	0.040	-0.088	0.06	143.0	-2.2
2	1	90.00	0.28	11:42 AM	5.53	29.96	0.184	0.104	-0.010	0.14	143.7	0.1
2	2	90.00	0.87	11:42 AM	5.53	29.96	0.197	0.067	-0.010	0.17	144.0	-3.5
2	3	90.00	1.54	11:42 AM	5.53	29.96	0.148	0.124	-0.010	0.16	143.9	-2.5
2	4	90.00	2.30	11:42 AM	5.53	29.96	0.185	0.092	-0.011	0.18	144.0	-0.9
2	5	90.00	3.25	11:42 AM	5.53	29.96	0.179	0.053	-0.008	0.12	143.9	-2.3
2	6	90.00	4.62	11:42 AM	5.53	29.96	0.156	0.041	0.000	0.06	143.9	-3.8
3	1	180.00	0.28	11:44 AM	5.53	29.96	0.176	0.096	-0.005	-0.20	145.2	-0.9
3	2	180.00	0.87	11:44 AM	5.53	29.96	0.203	0.073	-0.004	0.18	143.7	-2.3
3	3	180.00	1.54	11:44 AM	5.53	29.96	0.172	0.145	-0.004	0.22	143.9	2.7
3	4	180.00	2.30	11:45 AM	5.53	29.95	0.200	0.067	-0.006	0.20	143.7	-3.3
3	5	180.00	3.25	11:45 AM	5.53	29.95	0.175	0.070	-0.003	0.16	143.7	-2.5
3	6	180.00	4.62	11:45 AM	5.53	29.96	0.138	0.051	-0.005	0.11	143.9	-10.0
4	1	270.00	0.28	11:47 AM	5.53	29.95	0.162	0.141	-0.016	0.20	143.8	4.3
4	2	270.00	0.87	11:47 AM	5.53	29.95	0.254	-0.027	-0.010	0.20	143.7	-9.3
4	3	270.00	1.54	11:48 AM	5.53	29.95	0.269	-0.046	-0.008	0.21	143.8	-9.5
4	4	270.00	2.30	11:48 AM	5.53	29.95	0.273	-0.105	-0.011	0.18	143.8	-14.5
4	5	270.00	3.25	11:48 AM	5.53	29.95	0.110	0.074	-0.001	0.11	143.1	1.2
4	6	270.00	4.62	11:48 AM	5.53	29.95	0.093	0.087	0.001	0.08	143.1	3.5

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 11:40 AM End Time: 11:48 AM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
2.4	-0.036	-1.3	1.066	0.183	-0.01	0.0639	30.9	30.9	-0.7	1.3	39,313	614,838	522,779
-2.0	-0.043	-1.8	1.067	0.247	-0.09	0.0639	36.0	35.9	-1.1	-1.3	45,701	715,481	607,725
-10.2	-0.022	-0.3	1.065	0.314	-0.17	0.0638	40.6	39.9	-0.2	-7.2	50,724	794,847	674,519
-0.3	0.013	2.2	1.064	0.216	-0.09	0.0582	35.3	35.2	1.4	-0.2	40,832	701,362	542,985
-3.3	-0.129	-7.6	1.076	0.186	-0.08	0.0610	31.9	31.6	-4.2	-1.8	38,414	629,264	510,830
-2.2	-0.682	-32.1	1.131	0.166	-0.11	0.0639	29.5	24.9	-15.7	-1.0	31,704	496,333	421,598
0.1	-0.057	-2.7	1.068	0.210	-0.07	0.0638	33.2	33.2	-1.6	0.1	42,134	660,217	560,293
-3.5	-0.050	-2.3	1.067	0.225	-0.06	0.0638	34.3	34.3	-1.3	-2.1	43,507	682,007	578,556
-2.5	-0.070	-3.6	1.069	0.169	-0.01	0.0638	29.8	29.7	-1.9	-1.3	37,696	590,804	501,272
-0.9	-0.062	-3.1	1.068	0.211	-0.03	0.0638	33.3	33.2	-1.8	-0.5	42,221	661,841	561,452
-2.3	-0.046	-2.0	1.067	0.204	-0.08	0.0638	32.7	32.6	-1.1	-1.3	41,456	649,855	551,272
-3.8	-0.003	1.1	1.065	0.176	-0.11	0.0638	30.4	30.4	0.6	-2.0	38,555	604,400	512,702
-0.9	-0.028	-0.7	1.066	0.200	-0.40	0.0636	32.5	32.5	-0.4	-0.5	41,115	646,333	546,737
-2.3	-0.018	0.0	1.065	0.231	-0.05	0.0638	34.8	34.8	0.0	-1.4	44,175	692,287	587,432
2.7	-0.025	-0.5	1.066	0.195	0.02	0.0638	32.0	31.9	-0.3	1.5	40,560	635,670	539,367
-3.3	-0.032	-1.0	1.066	0.227	-0.03	0.0638	34.5	34.5	-0.6	-2.0	43,810	686,510	582,579
-2.5	-0.016	0.1	1.065	0.198	-0.04	0.0638	32.2	32.2	0.1	-1.4	40,927	641,360	544,247
-10.0	-0.038	-1.4	1.066	0.157	-0.05	0.0638	28.7	28.2	-0.7	-5.0	35,880	562,407	477,130
4.3	-0.098	-5.5	1.072	0.187	0.01	0.0638	31.3	31.0	-3.0	2.3	39,446	618,192	524,551
-9.3	-0.041	-1.6	1.067	0.288	-0.09	0.0638	38.9	38.4	-1.1	-6.3	48,755	764,204	648,333
-9.5	-0.029	-0.8	1.066	0.305	-0.09	0.0638	40.0	39.5	-0.6	-6.6	50,147	786,133	666,847
-14.5	-0.042	-1.7	1.067	0.311	-0.13	0.0638	40.4	39.1	-1.2	-10.1	49,621	777,931	659,848
1.2	-0.007	0.8	1.065	0.125	-0.01	0.0639	25.6	25.6	0.4	0.5	32,527	509,279	432,543
3.5	0.009	1.9	1.064	0.105	-0.02	0.0639	23.5	23.4	0.8	1.4	29,760	465,911	395,743

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Thursday, 3/20/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.906667
Water Vapor Volume Fraction, Bws [-]:	0.2175331
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1769.2

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	975,521	270.98	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	15,302,714	255,045	249,383
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	13,392,453	223,208	218,252
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	10,479,152	174,653	170,780

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	25.7	38.4	32.0	32.0
Temperature [°F]:	139.4	144.4	143.8	143.9
Wet Gas Density [lbm/ft^3]:	0.0637	0.0642	0.0638	
Static Pressure [IWC]:	-0.24	0.02	-0.04	-0.04
Total Pressure [IWC]:	0.09	0.23	0.17	0.18
Barometric Pressure [“Hg at 32°F]:	29.93	29.94	29.93	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 1:00 PM End Time: 1:16 PM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/20/14 08:11 AM	15	17.1	17.01

Probe Used	Generic_Uncalibrated						
RsIo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.013	0.026	0.000	-0.001	0.00	12:59 PM
POST	0.000	0.012	0.030	0.000	-0.002	0.00	1:18 PM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 1:00 PM End Time: 1:16 PM
Formatting Parameters

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	1:00 PM	5.53	29.94	0.193	0.082	0.014	0.18	143.9	1.7
1	2	0.00	0.87	1:01 PM	5.53	29.94	0.256	-0.026	0.020	0.23	144.2	-8.7
1	3	0.00	1.54	1:01 PM	5.53	29.94	0.210	0.049	-0.003	0.23	144.1	-2.1
1	4	0.00	2.30	1:08 PM	5.53	29.94	0.210	0.020	-0.028	0.20	144.1	-4.3
1	5	0.00	3.25	1:01 PM	5.53	29.94	0.179	-0.094	0.129	0.09	143.7	-14.3
1	6	0.00	4.62	1:02 PM	5.53	29.93	0.133	0.063	0.115	0.13	143.6	-0.9
2	1	90.00	0.28	1:10 PM	5.53	29.93	0.180	0.074	-0.005	0.19	144.3	0.9
2	2	90.00	0.87	1:11 PM	5.53	29.93	0.194	0.083	-0.006	0.23	144.4	0.8
2	3	90.00	1.54	1:11 PM	5.53	29.93	0.208	0.064	-0.005	0.21	144.4	-1.5
2	4	90.00	2.30	1:11 PM	5.53	29.93	0.220	-0.013	-0.005	0.19	144.2	-6.9
2	5	90.00	3.25	1:11 PM	5.53	29.93	0.125	0.058	0.001	0.12	144.0	0.6
2	6	90.00	4.62	1:11 PM	5.53	29.93	0.124	0.045	0.000	0.09	143.6	0.6
3	1	180.00	0.28	1:12 PM	5.53	29.93	0.208	0.050	-0.005	0.22	144.3	-1.8
3	2	180.00	0.87	1:12 PM	5.53	29.93	0.176	0.109	-0.007	0.22	144.2	3.7
3	3	180.00	1.54	1:12 PM	5.53	29.93	0.170	0.109	-0.006	0.21	144.2	3.4
3	4	180.00	2.30	1:12 PM	5.53	29.93	0.184	0.047	-0.007	0.18	143.8	-4.0
3	5	180.00	3.25	1:12 PM	5.53	29.93	0.135	0.034	-0.002	0.13	139.4	-2.4
3	6	180.00	4.62	1:13 PM	5.53	29.93	0.113	0.058	0.007	0.11	143.2	1.4
4	1	270.00	0.28	1:14 PM	5.53	29.93	0.248	-0.046	-0.002	0.20	144.2	-10.8
4	2	270.00	0.87	1:14 PM	5.53	29.93	0.152	0.289	-0.006	0.19	143.8	7.4
4	3	270.00	1.54	1:15 PM	5.53	29.93	0.153	0.286	-0.009	0.18	144.1	7.3
4	4	270.00	2.30	1:15 PM	5.53	29.93	0.170	0.076	-0.008	0.19	144.0	-0.3
4	5	270.00	3.25	1:16 PM	5.53	29.93	0.141	0.119	-0.005	0.15	144.0	3.4
4	6	270.00	4.62	1:16 PM	5.53	29.93	0.157	0.004	0.002	0.11	144.0	-7.5

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 1:00 PM End Time: 1:16 PM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
1.7	0.075	6.7	1.065	0.219	-0.04	0.0638	33.9	33.6	4.0	1.0	42,710	669,917	567,954
-8.7	0.078	6.9	1.065	0.291	-0.06	0.0637	39.1	38.4	4.7	-5.9	48,672	763,798	647,235
-2.1	-0.015	0.2	1.065	0.238	-0.01	0.0637	35.4	35.3	0.1	-1.3	44,841	703,526	596,291
-4.3	-0.135	-7.9	1.077	0.243	-0.04	0.0637	35.7	35.3	-4.9	-2.7	44,789	702,729	595,594
-14.3	0.720	40.0	1.363	0.333	-0.24	0.0637	41.8	31.0	26.9	-7.9	39,378	617,803	523,643
-0.9	0.863	40.0	1.363	0.247	-0.12	0.0638	36.0	27.6	23.2	-0.4	35,051	549,685	466,106
0.9	-0.029	-0.8	1.066	0.204	-0.01	0.0637	32.8	32.8	-0.5	0.5	41,535	652,072	552,331
0.8	-0.033	-1.0	1.066	0.221	0.01	0.0637	34.1	34.1	-0.6	0.5	43,183	677,939	574,246
-1.5	-0.025	-0.5	1.066	0.236	-0.02	0.0637	35.2	35.2	-0.3	-0.9	44,609	700,384	593,200
-6.9	-0.021	-0.2	1.065	0.249	-0.06	0.0637	36.2	35.9	-0.1	-4.3	45,583	715,580	606,156
0.6	0.007	1.8	1.064	0.141	-0.02	0.0637	27.2	27.2	0.8	0.3	34,526	541,724	459,119
0.6	0.001	1.3	1.064	0.141	-0.05	0.0638	27.2	27.2	0.6	0.3	34,479	540,701	458,504
-1.8	-0.023	-0.3	1.065	0.236	-0.02	0.0637	35.2	35.2	-0.2	-1.1	44,688	701,441	594,259
3.7	-0.038	-1.4	1.066	0.201	0.02	0.0637	32.5	32.4	-0.8	2.1	41,088	644,852	546,383
3.4	-0.033	-1.0	1.066	0.193	0.02	0.0637	31.8	31.8	-0.6	1.9	40,317	632,756	536,128
-4.0	-0.038	-1.4	1.066	0.209	-0.03	0.0638	33.1	33.0	-0.8	-2.3	41,941	657,841	557,729
-2.4	-0.013	0.3	1.065	0.153	-0.03	0.0642	28.2	28.2	0.2	-1.2	36,056	561,429	479,475
1.4	0.063	5.9	1.065	0.128	-0.02	0.0638	25.9	25.7	2.6	0.6	32,681	512,097	434,584
-10.8	-0.007	0.8	1.065	0.281	-0.08	0.0637	38.4	37.7	0.5	-7.2	47,875	751,545	636,637
7.4	-0.037	-1.4	1.066	0.173	0.02	0.0638	30.1	29.9	-0.7	3.9	37,931	594,913	504,404
7.3	-0.060	-2.9	1.068	0.174	0.01	0.0637	30.3	30.0	-1.6	3.8	38,027	596,701	505,682
-0.3	-0.049	-2.2	1.067	0.193	0.00	0.0637	31.9	31.9	-1.2	-0.2	40,421	634,242	537,520
3.4	-0.038	-1.4	1.066	0.161	-0.01	0.0637	29.0	29.0	-0.7	1.7	36,778	577,109	489,072
-7.5	0.011	2.1	1.064	0.177	-0.07	0.0637	30.5	30.2	1.1	-4.0	38,359	601,927	510,098

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 2 Condition 1
Personnel:	A Christiansen
Date:	Thursday, 3/20/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.906667
Water Vapor Volume Fraction, Bws [-]:	0.2175331
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1769.2

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	942,632	261.84	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	14,819,128	246,985	241,502
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	12,940,206	215,670	210,882
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	10,125,283	168,755	165,013

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	18.2	36.7	31.0	31.0
Temperature [°F]:	144.2	144.9	144.5	144.5
Wet Gas Density [lbm/ft^3]:	0.0636	0.0636	0.0636	
Static Pressure [IWC]:	-0.16	0.07	-0.02	-0.03
Total Pressure [IWC]:	-0.03	0.24	0.18	0.19
Barometric Pressure [°Hg at 32°F]:	29.89	29.90	29.90	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 2:20 PM End Time: 2:37 PM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/20/14 08:11 AM	15	17.1	17.01

Probe Used	Generic_Uncalibrated
Rslo	0
Probe Calibration Date	3/11/2014

	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (In IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.014	0.028	0.000	0.236	0.00	2:19 PM
POST	0.000	0.016	-0.069	0.000	0.384	0.02	2:37 PM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 2:20 PM End Time: 2:37 PM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	2:20 PM	5.53	29.90	0.188	0.108	0.038	0.18	144.7	2.4
1	2	0.00	0.87	2:20 PM	5.53	29.90	0.211	0.062	-0.011	0.21	144.9	-1.6
1	3	0.00	1.54	2:20 PM	5.53	29.90	0.192	0.093	-0.011	0.20	144.7	1.0
1	4	0.00	2.30	2:20 PM	5.53	29.90	0.180	0.111	-0.011	0.18	144.4	2.2
1	5	0.00	3.25	2:21 PM	5.53	29.90	0.108	0.206	-0.011	-0.03	144.8	9.6
1	6	0.00	4.62	2:21 PM	5.53	29.90	0.137	0.132	-0.009	0.17	144.8	5.3
2	1	90.00	0.28	2:23 PM	5.53	29.90	0.196	0.066	-0.052	0.22	144.6	1.1
2	2	90.00	0.87	2:23 PM	5.53	29.90	0.174	0.116	0.143	0.23	144.7	4.8
2	3	90.00	1.54	2:23 PM	5.53	29.90	0.200	0.092	0.156	0.21	144.7	0.7
2	4	90.00	2.30	2:23 PM	5.53	29.90	0.204	0.061	0.115	0.19	144.8	-0.8
2	5	90.00	3.25	2:23 PM	5.53	29.90	0.200	0.047	0.051	0.15	144.7	-0.1
2	6	90.00	4.62	2:34 PM	5.53	29.89	0.169	0.138	-0.008	0.19	144.3	1.3
3	1	180.00	0.28	2:34 PM	5.53	29.89	0.226	0.050	-0.001	0.18	144.2	-2.6
3	2	180.00	0.87	2:35 PM	5.53	29.89	0.200	0.128	-0.003	0.22	144.2	1.6
3	3	180.00	1.54	2:35 PM	5.53	29.89	0.178	0.198	-0.004	0.21	144.2	4.8
3	4	180.00	2.30	2:35 PM	5.53	29.89	0.226	0.052	-0.007	0.24	144.3	-3.4
3	5	180.00	3.25	2:35 PM	5.53	29.89	0.128	0.138	-0.016	0.20	144.3	4.9
3	6	180.00	4.62	2:35 PM	5.53	29.89	0.099	0.100	-0.028	0.14	144.2	4.7
4	1	270.00	0.28	2:36 PM	5.53	29.89	0.212	0.054	-0.070	0.21	144.2	-1.8
4	2	270.00	0.87	2:36 PM	5.53	29.89	0.194	0.106	-0.019	0.21	144.3	1.9
4	3	270.00	1.54	2:36 PM	5.53	29.89	0.218	0.064	0.007	0.23	144.4	-2.4
4	4	270.00	2.30	2:36 PM	5.53	29.89	0.151	0.103	-0.007	0.19	144.2	2.6
4	5	270.00	3.25	2:36 PM	5.53	29.89	0.081	0.255	0.036	0.16	144.3	11.2
4	6	270.00	4.62	2:37 PM	5.53	29.89	0.059	0.304	-0.003	0.13	144.3	13.5

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 2:20 PM End Time: 2:37 PM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
2.4	0.200	15.7	1.066	0.213	-0.03	0.0636	33.5	32.2	9.1	1.3	40,802	641,577	542,581
-1.6	-0.053	-2.4	1.068	0.240	-0.03	0.0636	35.6	35.5	-1.5	-1.0	44,957	707,153	597,834
1.0	-0.057	-2.8	1.068	0.219	-0.01	0.0636	34.0	33.9	-1.6	0.6	42,928	675,045	570,856
2.2	-0.059	-2.9	1.068	0.206	-0.02	0.0636	32.9	32.8	-1.7	1.2	41,609	653,977	553,312
9.6	-0.105	-6.0	1.073	0.125	-0.16	0.0636	25.6	25.1	-2.7	4.2	31,810	500,408	423,009
5.3	-0.062	-3.1	1.068	0.157	0.02	0.0636	28.7	28.6	-1.6	2.6	36,160	568,582	480,846
1.1	-0.267	-15.7	1.089	0.233	-0.02	0.0636	35.0	33.7	-9.5	0.6	42,650	670,612	567,156
4.8	0.821	40.0	1.363	0.323	-0.09	0.0636	41.2	31.5	26.5	2.6	39,847	626,629	529,874
0.7	0.780	40.0	1.363	0.372	-0.16	0.0636	44.3	33.9	28.5	0.4	42,914	675,069	570,662
-0.8	0.566	33.6	1.095	0.244	-0.05	0.0636	35.9	29.9	19.9	-0.4	37,797	594,494	502,623
-0.1	0.257	19.5	1.060	0.225	-0.07	0.0636	34.4	32.5	11.5	-0.1	41,106	646,405	546,618
1.3	-0.049	-2.2	1.067	0.193	0.00	0.0636	31.9	31.8	-1.2	0.7	40,316	633,612	536,123
-2.6	-0.002	1.1	1.065	0.256	-0.07	0.0636	36.7	36.6	0.7	-1.6	46,403	729,277	617,065
1.6	-0.014	0.3	1.065	0.227	-0.01	0.0636	34.6	34.6	0.2	1.0	43,787	688,179	582,276
4.8	-0.021	-0.2	1.065	0.202	0.01	0.0636	32.6	32.5	-0.1	2.7	41,134	646,373	546,992
-3.4	-0.033	-1.0	1.066	0.257	-0.02	0.0636	36.8	36.7	-0.7	-2.2	46,516	731,154	618,566
4.9	-0.121	-7.0	1.075	0.148	0.05	0.0636	27.9	27.6	-3.4	2.3	34,953	549,320	464,804
4.7	-0.281	-16.4	1.089	0.118	0.02	0.0636	24.9	23.8	-7.0	2.0	30,139	473,621	400,788
-1.8	-0.331	-18.9	1.089	0.252	-0.04	0.0636	36.4	34.4	-11.8	-1.1	43,582	684,984	579,543
1.9	-0.096	-5.4	1.072	0.222	-0.01	0.0636	34.2	34.0	-3.2	1.1	43,118	677,750	573,373
-2.4	0.033	3.7	1.064	0.247	-0.02	0.0636	36.1	36.0	2.3	-1.5	45,534	715,844	605,504
2.6	-0.045	-1.9	1.067	0.172	0.02	0.0636	30.1	30.0	-1.0	1.4	38,030	597,655	505,721
11.2	0.448	29.4	1.050	0.089	0.07	0.0636	21.7	18.5	10.6	3.7	23,445	368,454	311,765
13.5	-0.043	-1.8	1.067	0.067	0.07	0.0636	18.8	18.2	-0.6	4.4	23,094	362,953	307,103

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 1 Condition 1
Personnel:	A Christiansen
Date:	Friday, 3/21/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	11
Dry Gas Molecular Weight (g/mol):	30.913333
Water Vapor Volume Fraction, Bws [-]:	0.2191245
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1770.1

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	936,104	260.03	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	14,824,166	247,069	241,584
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	12,838,126	213,969	209,219
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	10,024,978	167,083	163,379

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	6.2	39.5	31.0	31.0
Temperature [°F]:	101.4	153.3	144.0	145.0
Wet Gas Density [lbm/ft^3]:	0.0572	0.0635	0.0630	
Static Pressure [IWC]:	-3.69	0.05	-0.74	-0.74
Total Pressure [IWC]:	-3.54	0.21	-0.52	-0.51
Barometric Pressure ["Hg at 32°F]:	25.01	29.89	29.68	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 7:53 AM End Time: 8:15 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/21/14 07:50 AM	15	18.99	19.03

Probe Used	Generic_Uncalibrated
Rslo	0
Probe Calibration Date	3/11/2014

	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.001	0.004	0.000	0.001	0.01	7:50 AM
POST	0.000	0.000	0.002	0.000	0.002	-0.21	8:17 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412
Site: 12461 Marathon
Start Time: 7:53 AM End Time: 8:15 AM
Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	7:53 AM	5.53	29.88	0.237	-0.132	-0.009	0.17	146.3	-12.4
1	2	0.00	0.87	7:53 AM	5.53	29.88	0.152	0.105	-0.008	0.20	146.9	4.8
1	3	0.00	1.54	7:54 AM	5.53	29.88	0.195	0.073	-0.008	0.21	145.4	2.8
1	4	0.00	2.30	7:54 AM	5.53	29.88	0.134	0.060	-0.007	0.15	145.2	2.3
1	5	0.00	3.25	7:55 AM	5.53	29.88	0.137	0.131	-0.007	0.21	145.8	8.3
1	9	0.00	4.62	7:57 AM	5.53	29.88	0.124	-0.025	0.033	0.11	144.9	-3.8
2	1	90.00	0.28	8:00 AM	5.53	29.88	0.264	-0.061	-0.010	-0.96	145.2	-7.4
2	2	90.00	0.87	8:00 AM	5.53	29.88	0.235	0.007	-0.009	-0.87	145.4	-2.6
2	3	90.00	1.54	8:00 AM	5.53	29.88	0.189	0.082	-0.012	-0.86	145.2	2.1
2	4	90.00	2.30	8:00 AM	5.53	29.88	0.160	0.127	-0.012	-0.92	145.1	6.0
2	5	90.00	3.25	8:01 AM	5.53	29.88	0.181	0.005	0.138	-1.27	145.1	-2.9
2	9	90.00	4.62	8:02 AM	5.53	29.88	0.083	0.006	0.073	-3.54	144.9	0.5
3	1	180.00	0.28	8:06 AM	5.53	29.88	0.227	0.019	-0.007	-0.95	147.8	-1.6
3	2	180.00	0.87	8:06 AM	5.53	29.88	0.226	0.031	-0.005	-0.91	146.1	-1.5
3	3	180.00	1.54	8:06 AM	5.53	29.88	0.199	0.084	-0.006	-0.87	146.4	1.9
3	4	180.00	2.30	8:06 AM	5.53	29.88	0.191	0.084	-0.007	-0.83	153.3	1.1
3	5	180.00	3.25	8:07 AM	5.53	29.88	0.178	0.027	0.131	-0.72	145.1	-1.7
3	9	180.00	4.62	8:09 AM	5.53	29.88	0.007	0.022	-0.157	-0.58	145.1	2.6
4	1	270.00	0.28	8:12 AM	5.53	29.89	0.214	0.050	-0.012	-0.11	144.9	-0.1
4	2	270.00	0.87	8:13 AM	5.53	25.01	0.069	-1.184	-1.242	0.01	101.4	-38.1
4	3	270.00	1.54	8:14 AM	5.53	29.88	0.230	0.040	-0.011	-0.04	145.0	-1.1
4	4	270.00	2.30	8:14 AM	5.53	29.88	0.209	0.048	-0.015	-0.04	145.2	0.2
4	5	270.00	3.25	8:15 AM	5.53	29.88	0.207	0.063	-0.009	-0.02	145.2	0.5
4	9	270.00	4.62	8:15 AM	5.53	29.88	0.109	0.010	0.019	-0.16	144.5	-3.4

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 7:53 AM End Time: 8:15 AM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	*Wet Vol* Flow [WSCFH]
-12.4	-0.038	-1.4	1.066	0.270	-0.10	0.0633	37.7	36.9	-0.9	-8.1	46,472	733,760	617,977
4.8	-0.053	-2.5	1.068	0.173	0.03	0.0633	30.2	30.1	-1.3	2.5	37,915	599,059	504,192
2.8	-0.039	-1.5	1.066	0.222	-0.01	0.0634	34.2	34.2	-0.9	1.7	43,193	680,741	574,371
2.3	-0.051	-2.3	1.067	0.153	0.00	0.0635	28.4	28.3	-1.1	1.1	35,781	563,786	475,814
8.3	-0.051	-2.4	1.067	0.156	0.05	0.0634	28.7	28.3	-1.2	4.1	35,781	564,282	475,813
-3.8	0.268	20.2	1.059	0.139	-0.03	0.0635	27.1	25.4	9.3	-1.7	32,061	504,988	426,339
-7.4	-0.040	-1.5	1.066	0.300	-1.26	0.0633	39.8	39.5	-1.1	-5.1	49,754	786,330	661,626
-2.6	-0.039	-1.5	1.066	0.268	-1.13	0.0633	37.6	37.6	-1.0	-1.7	47,341	748,181	629,537
2.1	-0.063	-3.2	1.069	0.216	-1.08	0.0633	33.8	33.7	-1.9	1.2	42,461	670,713	564,637
6.0	-0.072	-3.8	1.069	0.183	-1.10	0.0633	31.1	30.9	-2.1	3.3	38,951	615,293	517,970
-2.9	0.763	40.0	1.363	0.337	-1.61	0.0632	42.2	32.3	27.1	-1.7	40,656	643,045	540,640
0.5	0.891	40.0	1.363	0.153	-3.69	0.0629	28.6	21.9	18.4	0.2	27,400	435,440	364,356
-1.6	-0.031	-0.9	1.066	0.258	-1.21	0.0630	37.0	37.0	-0.6	-1.0	46,429	736,897	617,413
-1.5	-0.022	-0.3	1.065	0.256	-1.16	0.0632	36.9	36.8	-0.2	-1.0	46,353	733,465	616,403
1.9	-0.031	-0.9	1.066	0.226	-1.09	0.0632	34.6	34.6	-0.6	1.2	43,480	688,230	578,191
1.1	-0.038	-1.4	1.066	0.217	-1.05	0.0625	34.1	34.1	-0.8	0.6	42,439	679,376	564,347
-1.7	0.735	40.0	1.363	0.330	-1.05	0.0633	41.8	32.0	26.8	-1.0	40,320	636,781	536,165
2.6	-23.545	40.0	1.363	0.012	-0.60	0.0634	8.1	6.2	5.2	0.3	7,802	123,084	103,756
-0.1	-0.057	-2.7	1.068	0.244	-0.35	0.0635	35.9	35.9	-1.7	-0.1	45,317	713,926	602,620
-38.1	-17.905	40.0	1.363	0.129	-0.12	0.0572	27.4	16.5	17.6	-13.0	18,860	329,469	250,799
-1.1	-0.047	-2.0	1.067	0.261	-0.30	0.0635	37.1	37.1	-1.3	-0.7	46,871	738,704	623,281
0.2	-0.070	-3.6	1.069	0.239	-0.28	0.0634	35.5	35.4	-2.3	0.2	44,764	705,704	595,261
0.5	-0.046	-2.0	1.067	0.235	-0.26	0.0634	35.2	35.2	-1.2	0.3	44,460	700,930	591,226
-3.4	0.178	14.1	1.067	0.124	-0.28	0.0635	25.5	24.7	6.2	-1.5	31,242	491,983	415,457

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 1 Condition 1
Personnel:	A Christiansen
Date:	Friday, 3/21/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.913333
Water Vapor Volume Fraction, Bws [-]:	0.2191245
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1770.1

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,081,885	300.52	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	17,703,892	295,065	288,514
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	14,664,946	244,416	238,990
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	11,451,497	190,858	186,627

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	27.2	48.6	37.1	37.1
Temperature [°F]:	144.6	562.3	177.1	168.7
Wet Gas Density [lbm/ft^3]:	0.0376	0.0636	0.0613	
Static Pressure [IWC]:	-0.27	0.08	-0.02	-0.03
Total Pressure [IWC]:	0.17	0.32	0.24	0.25
Barometric Pressure [*Hg at 32°F]:	29.88	29.89	29.89	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 9:08 AM End Time: 9:55 AM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/21/14 09:04 AM	15	20.45	20.48

Probe Used	Generic_Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (In IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	-0.001	0.005	0.000	0.000	-0.01	9:06 AM
POST	0.000	0.005	0.020	0.000	0.002	0.03	9:57 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 9:08 AM End Time: 9:55 AM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Palm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	9:08 AM	5.53	29.89	0.173	0.161	-0.001	0.23	145.4	5.1
1	2	0.00	0.87	9:08 AM	5.53	29.88	0.425	-0.271	-0.001	0.21	145.8	-15.5
1	3	0.00	1.54	9:08 AM	5.53	29.88	0.379	-0.204	-0.005	0.23	145.8	-13.0
1	4	0.00	2.30	9:09 AM	5.53	29.89	0.302	-0.128	-0.008	0.22	146.0	-10.5
1	5	0.00	3.25	9:09 AM	5.53	29.89	0.192	0.095	-0.056	0.22	146.5	7.0
1	6	0.00	4.62	9:09 AM	5.53	29.89	0.126	0.065	0.006	0.17	562.3	2.9
2	1	90.00	0.28	9:33 AM	5.53	29.89	0.162	0.217	0.002	0.25	144.6	5.2
2	2	90.00	0.87	9:33 AM	5.53	29.89	0.254	0.001	0.001	0.25	145.2	-2.7
2	3	90.00	1.54	9:34 AM	5.53	29.89	0.265	0.060	-0.002	0.28	145.2	-0.6
2	4	90.00	2.30	9:36 AM	5.53	29.89	0.193	0.073	-0.006	0.25	145.3	0.9
2	5	90.00	3.25	9:36 AM	5.53	29.89	0.158	0.078	-0.006	0.21	145.3	2.2
2	6	90.00	4.62	9:37 AM	5.53	29.89	0.227	-0.026	-0.004	0.22	145.2	-3.9
3	1	180.00	0.28	9:44 AM	5.53	29.89	0.257	0.024	0.002	0.24	145.1	-2.8
3	2	180.00	0.87	9:44 AM	5.53	29.89	0.238	0.053	0.038	0.26	146.7	-3.3
3	3	180.00	1.54	9:45 AM	5.53	29.89	0.211	0.076	0.090	0.24	213.6	-0.8
3	4	180.00	2.30	9:45 AM	5.53	29.89	0.278	-0.030	-0.009	0.27	164.7	-8.4
3	5	180.00	3.25	9:51 AM	5.53	29.89	0.262	-0.034	-0.006	0.32	400.8	-7.1
3	6	180.00	4.62	9:52 AM	5.53	29.89	0.267	-0.095	0.014	0.21	145.1	-9.0
4	1	270.00	0.28	9:53 AM	5.53	29.89	0.155	0.144	0.002	0.26	145.1	6.5
4	2	270.00	0.87	9:53 AM	5.53	29.89	0.228	0.062	-0.005	0.28	145.1	-0.6
4	3	270.00	1.54	9:54 AM	5.53	29.89	0.269	-0.001	-0.011	0.31	145.3	-5.1
4	4	270.00	2.30	9:54 AM	5.53	29.89	0.273	-0.014	-0.028	0.28	145.6	-4.4
4	5	270.00	3.25	9:55 AM	5.53	29.89	0.155	0.082	-0.013	0.25	145.3	1.4
4	6	270.00	4.62	9:55 AM	5.53	29.89	0.125	0.072	-0.027	0.18	145.1	1.8

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 9:08 AM End Time: 9:55 AM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
5.1	-0.008	0.7	1.065	0.196	0.03	0.0635	32.2	32.0	0.4	2.9	40,491	638,057	538,448
-15.5	-0.003	1.1	1.065	0.482	-0.27	0.0634	50.5	48.6	1.0	-13.5	61,338	967,908	815,669
-13.0	-0.012	0.4	1.065	0.430	-0.20	0.0634	47.7	46.4	0.3	-10.7	58,592	924,394	779,155
-10.5	-0.028	-0.7	1.066	0.343	-0.13	0.0634	42.5	41.8	-0.5	-7.7	52,769	832,635	701,713
7.0	-0.292	-17.0	1.089	0.228	-0.01	0.0633	34.7	32.9	-10.1	4.0	41,542	655,804	552,421
2.9	0.044	4.4	1.064	0.143	0.03	0.0376	35.7	35.5	2.8	1.8	26,563	706,764	353,229
5.2	0.014	2.3	1.064	0.184	0.06	0.0636	31.1	30.9	1.3	2.8	39,150	615,903	520,606
-2.7	0.003	1.5	1.064	0.288	-0.04	0.0635	39.0	38.9	1.0	-1.8	49,185	774,676	654,057
-0.6	-0.007	0.8	1.065	0.301	-0.03	0.0635	39.8	39.8	0.5	-0.4	50,326	792,622	669,228
0.9	-0.032	-1.0	1.066	0.220	0.03	0.0635	34.0	34.0	-0.6	0.5	43,020	677,623	572,079
2.2	-0.037	-1.3	1.066	0.180	0.03	0.0635	30.8	30.8	-0.7	1.2	38,890	612,458	517,154
-3.9	-0.019	-0.1	1.065	0.257	-0.04	0.0635	36.8	36.8	-0.1	-2.5	46,464	731,798	617,866
-2.8	0.008	1.8	1.064	0.291	-0.05	0.0635	39.2	39.1	1.3	-1.9	49,450	778,790	657,576
-3.3	0.161	13.0	1.067	0.271	-0.01	0.0633	37.8	36.8	8.5	-2.1	46,428	732,946	617,388
-0.8	0.426	28.5	1.048	0.231	0.01	0.0570	36.9	32.4	17.6	-0.4	36,771	644,553	488,970
-8.4	-0.033	-1.1	1.066	0.316	-0.04	0.0615	41.5	41.0	-0.8	-6.1	50,223	816,527	667,854
-7.1	-0.024	-0.4	1.065	0.298	0.03	0.0446	47.2	46.9	-0.3	-5.9	41,658	933,285	553,959
-9.0	0.054	5.2	1.064	0.302	-0.09	0.0635	39.9	39.3	3.6	-6.2	49,628	781,723	659,949
6.5	0.012	2.2	1.064	0.176	0.08	0.0635	30.4	30.2	1.2	3.5	38,210	601,574	508,115
-0.6	-0.023	-0.3	1.065	0.259	0.03	0.0635	36.9	36.9	-0.2	-0.4	46,673	734,918	620,647
-5.1	-0.042	-1.7	1.067	0.306	0.00	0.0635	40.2	40.0	-1.2	-3.6	50,527	795,925	671,905
-4.4	-0.103	-5.9	1.073	0.315	-0.04	0.0635	40.7	40.4	-4.2	-3.1	51,045	804,410	678,796
1.4	-0.082	-4.4	1.070	0.178	0.07	0.0635	30.6	30.5	-2.4	0.7	38,582	607,591	513,057
1.8	-0.218	-13.0	1.086	0.148	0.04	0.0635	27.9	27.2	-6.3	0.9	34,361	541,008	456,927

Airflow Sciences Corporation

Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 1 Condition 1
Personnel:	A Christiansen
Date:	Friday, 3/21/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.913333
Water Vapor Volume Fraction, Bws [-]:	0.2191245
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1770.1

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,023,032	284.18	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	16,127,372	268,790	262,822
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	14,054,347	234,239	229,039
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	10,974,695	182,912	178,856

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	17.9	40.0	33.8	33.8
Temperature [°F]:	144.3	164.3	145.8	146.0
Wet Gas Density [lbm/ft^3]:	0.0616	0.0636	0.0635	
Static Pressure [IWC]:	0.00	0.16	0.07	0.06
Total Pressure [IWC]:	0.21	0.37	0.29	0.30
Barometric Pressure [“Hg at 32°F]:	29.89	29.90	29.90	

3DDAS011 Calibrated: 05/22/2013

3-D Probe v.4.10.r7

Start Time: 11:01 AM End Time: 11:24 AM

Formatting Parameters

Velocities in fpm False

Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/21/14 09:04 AM	15	20.45	20.48

Probe Used	Generic_Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (In IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.010	0.034	0.000	0.002	0.09	11:00 AM
POST	0.000	0.006	0.042	0.000	-0.004	0.07	11:46 AM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:

1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 11:01 AM End Time: 11:24 AM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	11:01 AM	5.53	29.90	0.182	0.119	0.006	0.30	144.3	2.9
1	2	0.00	0.87	11:01 AM	5.53	29.90	0.232	0.079	-0.001	0.30	145.1	-1.1
1	3	0.00	1.54	11:01 AM	5.53	29.90	0.255	0.049	-0.002	0.30	145.1	-2.0
1	4	0.00	2.30	11:01 AM	5.53	29.90	0.210	0.101	-0.001	0.29	145.2	1.0
1	5	0.00	3.25	11:02 AM	5.53	29.90	0.183	0.071	0.000	0.29	145.1	-0.3
1	6	0.00	4.62	11:02 AM	5.53	29.90	0.152	0.051	0.035	0.26	144.9	0.1
2	1	90.00	0.28	11:03 AM	5.53	29.90	0.209	0.073	0.010	0.28	145.0	-0.1
2	2	90.00	0.87	11:03 AM	5.53	29.90	0.208	0.094	-0.003	0.30	145.2	0.4
2	3	90.00	1.54	11:03 AM	5.53	29.90	0.199	0.118	-0.005	0.29	145.3	2.2
2	4	90.00	2.30	11:03 AM	5.53	29.90	0.195	0.117	-0.003	0.31	145.5	2.0
2	5	90.00	3.25	11:03 AM	5.53	29.90	0.168	0.094	0.031	0.28	146.2	1.6
2	6	90.00	4.62	11:04 AM	5.53	29.90	0.141	0.069	0.065	0.25	144.8	0.5
3	1	180.00	0.28	11:18 AM	5.53	29.90	0.273	-0.034	-0.003	0.35	144.5	-8.1
3	2	180.00	0.87	11:18 AM	5.53	29.90	0.261	0.035	0.004	0.37	164.3	-2.8
3	3	180.00	1.54	11:18 AM	5.53	29.90	0.229	0.105	0.001	0.33	145.0	1.6
3	4	180.00	2.30	11:19 AM	5.53	29.90	0.252	0.027	-0.003	0.33	145.1	-3.7
3	5	180.00	3.25	11:20 AM	5.53	29.90	0.121	0.091	0.082	0.21	145.0	1.8
3	6	180.00	4.62	11:22 AM	5.53	29.90	0.057	0.265	-0.001	0.22	144.8	13.5
4	1	270.00	0.28	11:22 AM	5.53	29.90	0.212	0.076	0.003	0.30	145.1	-1.5
4	2	270.00	0.87	11:22 AM	5.53	29.90	0.262	0.048	0.000	0.30	145.0	-2.5
4	3	270.00	1.54	11:22 AM	5.53	29.90	0.241	0.125	-0.002	0.32	145.0	0.1
4	4	270.00	2.30	11:23 AM	5.53	29.90	0.217	0.107	-0.006	0.31	144.9	1.0
4	5	270.00	3.25	11:23 AM	5.53	29.90	0.188	0.091	-0.004	0.30	144.9	0.6
4	6	270.00	4.62	11:24 AM	5.53	29.89	0.135	0.056	-0.003	0.22	144.9	-1.4

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 11:01 AM
Formatting Parameters

End Time: 11:24 AM

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
2.9	0.034	3.7	1.064	0.207	0.09	0.0636	33.0	32.9	2.1	1.7	41,622	654,269	553,479
-1.1	-0.003	1.0	1.065	0.263	0.04	0.0635	37.3	37.2	0.7	-0.7	47,096	741,443	626,277
-2.0	-0.006	0.9	1.065	0.289	0.01	0.0635	39.0	39.0	0.6	-1.4	49,338	776,762	656,091
1.0	-0.005	0.9	1.065	0.238	0.06	0.0635	35.4	35.4	0.6	0.6	44,801	705,343	595,753
-0.3	0.000	1.3	1.064	0.207	0.09	0.0635	33.0	33.0	0.7	-0.2	41,745	657,125	555,115
0.1	0.231	17.8	1.063	0.172	0.09	0.0635	30.1	28.7	9.2	0.0	36,272	570,772	482,337
-0.1	0.046	4.6	1.064	0.237	0.05	0.0635	35.3	35.2	2.8	-0.1	44,535	700,922	592,227
0.4	-0.015	0.2	1.065	0.236	0.06	0.0635	35.3	35.3	0.1	0.3	44,625	702,604	593,412
2.2	-0.025	-0.5	1.066	0.226	0.07	0.0635	34.5	34.5	-0.3	1.3	43,611	686,755	579,933
2.0	-0.017	0.0	1.065	0.221	0.08	0.0635	34.1	34.1	0.0	1.2	43,111	679,020	573,285
1.6	0.184	14.6	1.067	0.191	0.09	0.0634	31.7	30.7	8.0	0.8	38,772	611,340	515,592
0.5	0.460	29.9	1.053	0.157	0.09	0.0636	28.7	24.9	14.3	0.2	31,500	495,585	418,888
-8.1	-0.010	0.6	1.065	0.310	0.04	0.0636	40.4	40.0	0.4	-5.7	50,625	795,963	673,201
-2.8	0.016	2.4	1.064	0.296	0.07	0.0616	40.1	40.0	1.7	-2.0	49,083	797,078	652,695
1.6	0.004	1.6	1.064	0.260	0.07	0.0635	37.0	37.0	1.0	1.0	46,770	736,118	621,943
-3.7	-0.013	0.3	1.065	0.285	0.05	0.0635	38.8	38.7	0.2	-2.5	48,955	770,667	650,991
1.8	0.679	38.0	1.239	0.185	0.03	0.0635	31.2	24.6	19.2	0.8	31,128	490,024	413,938
13.5	-0.021	-0.2	1.065	0.065	0.16	0.0636	18.5	17.9	-0.1	4.3	22,704	357,175	301,908
-1.5	0.013	2.2	1.064	0.240	0.06	0.0635	35.5	35.5	1.4	-0.9	44,886	706,592	596,886
-2.5	-0.002	1.2	1.064	0.297	0.00	0.0635	39.5	39.5	0.8	-1.8	49,953	786,344	664,273
0.1	-0.010	0.6	1.065	0.273	0.05	0.0635	37.9	37.9	0.4	0.0	47,984	755,339	638,089
1.0	-0.029	-0.8	1.066	0.246	0.07	0.0635	36.0	36.0	-0.5	0.6	45,573	717,182	606,025
0.6	-0.019	-0.1	1.065	0.213	0.09	0.0635	33.5	33.5	0.0	0.4	42,427	667,647	564,183
-1.4	-0.024	-0.4	1.065	0.153	0.07	0.0635	28.4	28.4	-0.2	-0.7	35,917	565,304	477,625

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 1 Condition 1
Personnel:	A Christiansen
Date:	Friday, 3/21/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.913333
Water Vapor Volume Fraction, Bws [-]:	0.2191245
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1770.1

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,035,023	287.51	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	16,397,751	273,296	267,229
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	14,191,800	236,530	231,279
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	11,082,029	184,700	180,605

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	23.2	42.0	34.3	34.3
Temperature [°F]:	141.2	283.3	149.5	148.5
Wet Gas Density [lbm/ft^3]:	0.0517	0.0639	0.0631	
Static Pressure [IWC]:	-0.14	0.08	-0.03	-0.04
Total Pressure [IWC]:	0.14	0.28	0.20	0.21
Barometric Pressure [\"Hg at 32°F]:	29.87	29.89	29.88	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 12:34 PM End Time: 1:00 PM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/21/14 09:04 AM	15	20.45	20.48

Probe Used	Generic_Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.007	0.040	0.000	-0.002	0.11	12:33 PM
POST	0.000	0.011	0.031	0.000	-0.003	0.12	1:01 PM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412
Site: 12461 Marathon

Start Time: 12:34 PM
Formatting Parameters

End Time: 1:00 PM

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	12:34 PM	5.53	29.88	0.238	0.019	0.005	0.20	141.2	-2.6
1	2	0.00	0.87	12:35 PM	5.53	29.89	0.273	-0.026	0.000	0.21	142.5	-7.4
1	3	0.00	1.54	12:35 PM	5.53	29.89	0.217	0.088	-0.007	0.22	144.0	-0.2
1	4	0.00	2.30	12:35 PM	5.53	29.88	0.167	0.238	-0.006	0.21	144.0	5.3
1	5	0.00	3.25	12:36 PM	5.53	29.89	0.165	0.135	0.017	0.18	283.3	3.3
1	6	0.00	4.62	12:37 PM	5.53	29.89	0.091	0.110	0.003	0.15	143.4	3.8
2	1	90.00	0.28	12:39 PM	5.53	29.88	0.301	-0.071	0.012	0.20	144.1	-8.3
2	2	90.00	0.87	12:39 PM	5.53	29.88	0.221	0.058	0.058	0.17	143.8	-2.4
2	3	90.00	1.54	12:39 PM	5.53	29.88	0.286	-0.030	0.135	0.18	144.1	-9.5
2	4	90.00	2.30	12:40 PM	5.53	29.88	0.311	-0.088	0.030	0.24	143.8	-10.2
2	5	90.00	3.25	12:40 PM	5.53	29.88	0.276	-0.026	-0.006	0.24	143.7	-6.7
2	6	90.00	4.62	12:40 PM	5.53	29.88	0.238	-0.115	0.145	0.20	143.3	-15.0
3	1	180.00	0.28	12:57 PM	5.53	29.87	0.249	0.037	-0.007	0.23	144.0	-2.7
3	2	180.00	0.87	12:57 PM	5.53	29.88	0.246	0.046	-0.008	0.22	144.3	-2.3
3	3	180.00	1.54	12:57 PM	5.53	29.88	0.224	0.078	-0.009	0.20	143.8	-0.7
3	4	180.00	2.30	12:57 PM	5.53	29.88	0.214	0.064	-0.008	0.22	143.9	-0.8
3	5	180.00	3.25	12:58 PM	5.53	29.88	0.179	0.058	-0.007	0.17	143.8	-0.4
3	6	180.00	4.62	12:58 PM	5.53	29.87	0.126	0.087	-0.007	0.16	143.6	2.2
4	1	270.00	0.28	12:58 PM	5.53	29.87	0.197	0.103	0.019	0.26	143.7	1.6
4	2	270.00	0.87	12:59 PM	5.53	29.87	0.194	0.120	-0.008	0.27	144.1	2.7
4	3	270.00	1.54	12:59 PM	5.53	29.87	0.172	0.185	-0.008	0.28	144.1	5.2
4	4	270.00	2.30	12:59 PM	5.53	29.87	0.148	0.275	-0.012	0.23	144.1	6.8
4	5	270.00	3.25	12:59 PM	5.53	29.88	0.134	0.274	-0.010	0.15	143.9	6.9
4	6	270.00	4.62	1:00 PM	5.53	29.88	0.144	0.046	-0.006	0.14	143.7	-0.1

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 12:34 PM End Time: 1:00 PM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-2.6	0.020	2.7	1.064	0.269	-0.07	0.0639	37.6	37.5	1.8	-1.7	47,684	746,390	634,102
-7.4	0.001	1.3	1.064	0.310	-0.10	0.0637	40.3	40.0	0.9	-5.2	50,738	795,939	674,713
-0.2	-0.034	-1.1	1.066	0.247	-0.03	0.0636	36.0	36.0	-0.7	-0.2	45,614	717,191	606,564
5.3	-0.038	-1.4	1.066	0.190	0.02	0.0636	31.6	31.4	-0.8	2.9	39,817	626,030	529,486
3.3	0.100	8.6	1.066	0.188	-0.01	0.0517	34.9	34.4	5.2	2.0	35,424	685,313	471,058
3.8	0.028	3.3	1.064	0.103	0.04	0.0637	23.3	23.2	1.3	1.5	29,396	461,673	390,903
-8.3	0.041	4.3	1.064	0.341	-0.14	0.0636	42.4	41.8	3.2	-6.1	52,888	832,001	703,303
-2.4	0.260	19.7	1.060	0.249	-0.08	0.0636	36.2	34.0	12.2	-1.5	43,099	677,586	573,129
-9.5	0.471	30.4	1.055	0.319	-0.14	0.0636	41.0	34.9	20.7	-5.8	44,135	694,273	586,899
-10.2	0.098	8.4	1.066	0.353	-0.12	0.0636	43.1	42.0	6.3	-7.5	53,132	835,425	706,538
-6.7	-0.021	-0.2	1.065	0.313	-0.08	0.0636	40.6	40.3	-0.1	-4.7	51,088	802,982	679,361
-15.0	0.610	35.1	1.130	0.303	-0.11	0.0636	39.9	31.5	23.0	-8.5	39,967	627,944	531,481
-2.7	-0.029	-0.8	1.066	0.283	-0.06	0.0636	38.6	38.6	-0.5	-1.8	48,801	767,653	648,953
-2.3	-0.031	-0.9	1.066	0.279	-0.06	0.0635	38.3	38.3	-0.6	-1.5	48,470	762,789	644,548
-0.7	-0.040	-1.5	1.066	0.255	-0.05	0.0636	36.6	36.6	-1.0	-0.4	46,354	728,923	616,405
-0.8	-0.038	-1.4	1.066	0.244	-0.03	0.0636	35.8	35.8	-0.9	-0.5	45,321	712,676	602,674
-0.4	-0.040	-1.6	1.067	0.203	-0.03	0.0636	32.7	32.7	-0.9	-0.3	41,416	651,158	550,747
2.2	-0.058	-2.8	1.068	0.143	0.01	0.0636	27.5	27.4	-1.4	1.0	34,736	545,913	461,919
1.6	0.095	8.2	1.066	0.224	0.03	0.0636	34.3	34.0	4.9	0.9	43,007	676,053	571,895
2.7	-0.043	-1.8	1.067	0.221	0.05	0.0636	34.1	34.1	-1.1	1.6	43,136	678,480	573,615
5.2	-0.044	-1.8	1.067	0.196	0.08	0.0636	32.1	32.0	-1.0	2.9	40,503	637,026	538,601
6.8	-0.079	-4.3	1.070	0.170	0.06	0.0636	29.9	29.6	-2.2	3.5	37,509	589,953	498,787
6.9	-0.074	-3.9	1.070	0.153	0.00	0.0636	28.4	28.1	-1.9	3.4	35,586	559,536	473,214
-0.1	-0.039	-1.5	1.066	0.164	-0.02	0.0636	29.4	29.4	-0.8	0.0	37,202	584,844	494,708

Airflow Sciences Corporation
Round 3-D Duct Traverse (Stack)

Project:	12412
Site:	12461 Marathon
Task:	Method 2F
Location:	Garyville LA, Stack
Condition:	Test 1 Condition 1
Personnel:	A Christiansen
Date:	Friday, 3/21/2014

Duct Diameter [ft]:	13.00
Number of Test Ports:	4
Number of Test Points per Port:	6
Dry Gas Molecular Weight [g/mol]:	30.913333
Water Vapor Volume Fraction, Bws [-]:	0.2191245
Spec. Gas Constant [(ft-lbf)/(slug-°R)]:	1770.1

Test Data Summary

Total Wet Gas Mass Flow Rate [lbm/hr, lbm/s]:	1,038,153	288.38	2H Adjusted
Total Wet Gas Vol. Flow Rate, Qsw [WACFH, WACFM]:	16,996,926	283,282	276,993
Total Wet Gas Vol. Flow Rate, Qsw [WSCFH, WSCFM]:	14,207,061	236,784	231,528
Total Dry Gas Vol. Flow Rate, Qsd [DSCFH, DSCFM]:	11,093,946	184,899	180,800

	Min	Max	Avg	Avg*
Axial Velocity [ft/s]	24.9	48.7	35.6	35.6
Temperature [°F]:	142.2	503.6	170.3	168.0
Wet Gas Density [lbm/ft^3]:	0.0398	0.0637	0.0615	
Static Pressure [IWC]:	-0.22	0.10	0.02	0.01
Total Pressure [IWC]:	0.19	0.34	0.26	0.27
Barometric Pressure [“Hg at 32°F]:	29.83	29.84	29.84	

3DDAS011 Calibrated: 05/22/2013
3-D Probe v.4.10.r7
Start Time: 2:11 PM End Time: 2:27 PM
Formatting Parameters
Velocities in fpm False
Insertion Depths from Near Wall False

	Date/Time	Decay Time [s	Start P [IWC]	End P [IWC]
Last Leak Check	03/21/14 09:04 AM	15	20.45	20.48

Probe Used	Generic_Uncalibrated						
Rslo	0						
Probe Calibration Date	3/11/2014						
	X6	X5	X4	X3	X2	X1	Constant
Probe Pitch Angle Calibration (F1)	9.056E+01	6.133E+01	-7.234E+01	-7.226E+01	1.775E+01	7.184E+01	1.282E+00
Probe Velocity Calibration (F2)	2.498E-10	-1.960E-10	-3.375E-07	-1.401E-08	1.173E-04	-7.068E-04	1.065E+00

Pressure Transducer Zero Readings (in IWC)

	P1-P2 (low)	P1-P2 (high)	P2-P3	P4-P5 (low)	P4-P5 (high)	P1-Pbar	Time
PRE	0.000	0.049	-0.017	0.000	0.003	0.11	2:10 PM
POST	0.000	0.007	0.019	0.000	-0.004	0.09	2:28 PM
SN	60125972	40915142	70223952	70622645	70418554	3662543	
RANGE	0.0->1.0	0.0->5.0	-2.5->2.5	-0.5->0.5	-2.5->2.5	-69.2->69.2	

NOTES:
1. All averages are number averages, not flow weighted averages
2. Calculation of total mass flow rate (lbm/hr) is based on individual areas for each traverse point; these areas are not necessarily equal
3. Calculation of wet and dry volumetric flow rate (SCFH) is based on the number-average axial velocity (per EPA Method 2F) and hence assumes
4. Averages in column H are as follows: velocity - area-weighted, temperature - mass-weighted, pressure - volume-weighted

Project: 12412 Start Time: 2:11 PM End Time: 2:27 PM

Site: 12461 Marathon Formatting Parameters

Traverse Data

MEASURED VALUES												
Port	Point	Port Spacing [deg]	Withdrawal Distance [ft]	Time (Local)	Area [ft^2]	Patm ["Hg at 32°F]	P1-P2 [IWC]	P2-P3 [IWC]	P4-P5 [IWC]	P1-Pbar (Total P Gage) [IWC]	Temp [°F]	Yaw Null Angle [°]
1	1	0.00	0.28	2:11 PM	5.53	29.84	0.264	-0.022	-0.019	0.29	142.6	-2.9
1	2	0.00	0.87	2:11 PM	5.53	29.84	0.237	0.051	-0.008	0.29	144.3	1.2
1	3	0.00	1.54	2:11 PM	5.53	29.84	0.261	0.023	-0.010	0.29	166.9	-2.8
1	4	0.00	2.30	2:12 PM	5.53	29.84	0.257	-0.030	0.008	0.29	146.6	-4.1
1	5	0.00	3.25	2:12 PM	5.53	29.84	0.222	-0.052	-0.031	0.22	143.7	-6.9
1	6	0.00	4.62	2:12 PM	5.53	29.84	0.126	0.053	-0.012	0.22	172.7	6.4
2	1	90.00	0.28	2:13 PM	5.53	29.84	0.241	-0.001	-0.043	0.30	144.1	-2.8
2	2	90.00	0.87	2:13 PM	5.53	29.84	0.224	0.012	0.035	0.27	336.8	-4.7
2	3	90.00	1.54	2:14 PM	5.53	29.84	0.235	0.015	-0.029	0.30	144.9	-2.5
2	4	90.00	2.30	2:16 PM	5.53	29.84	0.201	0.057	0.001	0.28	144.3	-0.7
2	5	90.00	3.25	2:16 PM	5.53	29.84	0.167	0.037	-0.002	0.29	144.3	-2.0
2	6	90.00	4.62	2:17 PM	5.53	29.84	0.105	0.042	0.006	0.22	143.4	3.7
3	1	180.00	0.28	2:21 PM	5.53	29.84	0.223	0.022	0.014	0.33	143.6	-2.4
3	2	180.00	0.87	2:21 PM	5.53	29.84	0.235	0.023	-0.002	0.34	142.2	-3.2
3	3	180.00	1.54	2:21 PM	5.53	29.83	0.285	-0.089	-0.003	0.32	152.8	-9.0
3	4	180.00	2.30	2:21 PM	5.53	29.84	0.128	0.190	0.001	0.25	143.8	7.7
3	5	180.00	3.25	2:21 PM	5.53	29.84	0.170	-0.025	0.100	0.22	144.2	-8.5
3	6	180.00	4.62	2:22 PM	5.53	29.84	0.141	0.042	0.000	0.23	143.9	-1.6
4	1	270.00	0.28	2:23 PM	5.53	29.84	0.276	-0.088	-0.001	0.28	161.9	-11.1
4	2	270.00	0.87	2:23 PM	5.53	29.84	0.260	-0.169	0.000	0.27	503.6	-11.8
4	3	270.00	1.54	2:23 PM	5.53	29.84	0.414	-0.320	-0.012	0.25	144.3	-23.0
4	4	270.00	2.30	2:23 PM	5.53	29.84	0.138	0.102	-0.005	0.21	144.2	4.4
4	5	270.00	3.25	2:23 PM	5.53	29.83	0.151	0.037	-0.004	0.21	144.0	-2.7
4	6	270.00	4.62	2:27 PM	5.53	29.84	0.197	-0.069	0.000	0.19	144.0	-12.1

Project: 12412
Site: 12461 Marathon
Traverse Data

Start Time: 2:11 PM End Time: 2:27 PM
Formatting Parameters

CALCULATED VALUES													
Yaw Angle [°]	F1 [-]	Pitch Angle [°]	F2 [-]	Dynam P [IWC]	Static P [IWC]	Wet Gas Density [lbm/ft^3]	Total Velocity [ft/s]	Vaxial [ft/s]	Vpitch [ft/s]	Vyaw [ft/s]	Mass Flow [lbm/hr]	Wet Vol Flow [WACFH]	Wet Vol Flow [WSCFH]
-2.9	-0.074	-3.9	1.070	0.302	-0.01	0.0636	39.8	39.7	-2.7	-2.0	50,303	790,318	668,922
1.2	-0.033	-1.1	1.066	0.270	0.02	0.0635	37.7	37.7	-0.7	0.8	47,652	750,693	633,666
-2.8	-0.040	-1.5	1.066	0.297	0.00	0.0612	40.3	40.3	-1.1	-2.0	49,056	801,807	652,336
-4.1	0.033	3.7	1.064	0.291	0.00	0.0632	39.3	39.1	2.5	-2.8	49,227	778,545	654,618
-6.9	-0.140	-8.3	1.078	0.257	-0.03	0.0635	36.8	36.2	-5.3	-4.4	45,775	720,435	608,707
6.4	-0.093	-5.2	1.072	0.144	0.07	0.0606	28.2	27.9	-2.5	3.1	33,729	556,238	448,519
-2.8	-0.178	-10.6	1.082	0.282	0.02	0.0635	38.6	37.9	-7.1	-1.8	47,880	754,034	636,696
-4.7	0.157	12.7	1.057	0.255	0.01	0.0481	42.1	41.0	9.3	-3.4	39,275	815,836	522,278
-2.5	-0.125	-7.3	1.076	0.272	0.03	0.0634	37.9	37.5	-4.8	-1.6	47,403	747,448	630,358
-0.7	0.005	1.6	1.064	0.228	0.05	0.0635	34.6	34.6	1.0	-0.4	43,768	689,435	582,028
-2.0	-0.014	0.3	1.065	0.189	0.10	0.0635	31.6	31.5	0.2	-1.1	39,862	627,876	530,083
3.7	0.059	5.6	1.065	0.119	0.10	0.0636	25.0	24.9	2.4	1.6	31,479	495,109	418,599
-2.4	0.062	5.8	1.065	0.253	0.07	0.0636	36.5	36.3	3.7	-1.5	45,928	722,601	610,740
-3.2	-0.008	0.7	1.065	0.267	0.07	0.0637	37.4	37.4	0.5	-2.1	47,419	744,373	630,573
-9.0	-0.009	0.6	1.065	0.323	-0.01	0.0626	41.5	41.0	0.4	-6.5	51,129	816,928	679,912
7.7	0.009	1.9	1.064	0.145	0.10	0.0635	27.6	27.3	0.9	3.7	34,584	544,326	459,899
-8.5	0.590	34.4	1.112	0.210	0.01	0.0635	33.3	27.2	18.8	-4.1	34,338	540,913	456,616
-1.6	0.001	1.3	1.064	0.159	0.07	0.0635	29.0	29.0	0.7	-0.8	36,622	576,513	486,999
-11.1	-0.004	1.0	1.065	0.312	-0.04	0.0617	41.2	40.4	0.7	-8.0	49,603	804,243	659,615
-11.8	-0.001	1.2	1.064	0.295	-0.02	0.0398	49.8	48.7	1.1	-10.2	38,607	969,947	513,392
-23.0	-0.029	-0.8	1.066	0.470	-0.22	0.0634	49.8	45.9	-0.7	-19.4	57,915	912,961	770,152
4.4	-0.035	-1.2	1.066	0.157	0.05	0.0635	28.8	28.7	-0.6	2.2	36,297	571,718	482,672
-2.7	-0.024	-0.4	1.065	0.171	0.03	0.0635	30.1	30.0	-0.2	-1.4	37,953	597,680	504,688
-12.1	-0.002	1.1	1.065	0.223	-0.04	0.0635	34.3	33.5	0.7	-7.2	42,349	666,949	563,151

OPERATING DATA

Client:	Marathon
Plant:	Garyville, LA
Date:	3/18/2014

Test Condition:	#1
Data Recorder:	Scott Lehmann

Time	Gauge 1 - Steam Traced (psi)	Guage 2 - (psi)
9:39	2.0	3.0
10:20	2.0	3.0
11:30	2.0	3.0
13:00	2.5	3.0
18:20	3.0	3.5
19:15	2.5	3.0
Average	2.3	3.1

CleanAir ENGINEERING

OPERATING DATA

Client:	Marathon
Plant:	Garyville, LA
Date:	3/19/2014

Test Condition:	#2
Data Recorder:	Scott Lehmann

Time	Gauge 1 - Steam Traced (psi)	Guage 2 - (psi)
11:55	2.5	3.5
14:30	3.0	3.5
15:25	3.0	3.5
16:42	3.0	3.5
Average	2.9	3.5

CleanAir ENGINEERING

OPERATING DATA

Client:	Marathon
Plant:	Garyville, LA
Date:	3/20/2014

Test Condition:	#2
Data Recorder:	Scott Lehmann

Time	Gauge 1 - Steam Traced (psi)	Guage 2 - (psi)
9:08	2.5	3.5
11:35	3.5	3.5
12:30	3.0	3.5
13:30	2.5	3.5
14:23	2.5	3.5
Average	2.8	3.5

CleanAir ENGINEERING

OPERATING DATA

Client:	Marathon
Plant:	Garyville, LA
Date:	3/21/2014

Test Condition:	#1
Data Recorder:	Scott Lehmann

Time	Gauge 1 - Steam Traced (psi)	Guage 2 - (psi)
8:36	2.0	3.0
9:12	2.0	3.0
10:35	2.5	3.5
11:21	2.5	3.5
14:34	3.0	3.5
Average	2.4	3.3

CleanAir ENGINEERING

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LABORATORY DATA

G

Notes:

- Quality Assurance records for the gravimetric lab report are available upon request.
- Chromatograms for the HCN analysis are available upon request.

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: PMK

Date: 05/14

CleanAir.

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 5/202 (FPM/CPM)

☐ Draft Lab Data

Gravimetric Laboratory Data Summary for FPM

Run No.		Blank	1	2	3
Date (2014)			Mar 18	Mar 18	Mar 19
Start Time (approx.)			10:45	17:56	09:14
Stop Time (approx.)			12:01	19:09	10:23
	Analytical Detection Limits				
MDL_f	Minimum detection limit for filter (g)	0.00020			
MDL_s	Minimum detection limit for solvent rinse (g)	0.00025			
	Filter(s)				
m_{f1}	Filter No. 1 residue mass (g)		0.00576	0.01799	0.01510
m_{filter}	*Total filter residue (g)*		0.00576	0.01799	0.01510
	First Solvent Rinse				
	Acetone				
ρ_1	Density (g/mL)	0.785			
v_{s1}	Sample volume (mL)		112	107	87
v_{a1}	Aliquot volume (mL)	206	112	107	87
r_{a1}	Aliquot residue mass (g)	ND	0.00312	0.00243	0.00496
r_{s1}	Sample residue mass (g)		0.00312	0.00243	0.00496
m_{b1}	Allowable blank correction (g)		0.00000	0.00000	0.00000
m_1	Net residue mass (g)		0.00312	0.00243	0.00496
m_s	*Total Solvent Residue (g)*		0.00312	0.00243	0.00496
m_T	*Total Gravimetric Result (g)*		0.00888	0.02042	0.02006
m_D	*Total Gravimetric Detection Limit g)*		0.00045	0.00045	0.00045
m_n	*Total Filterable Particulate Matter (g)*		0.00888	0.02042	0.02006
n_{MDL}	*Number of Non-Detectable Fractions*		N/A	N/A	N/A
DLC	*Detection Level Classification*		ADL	ADL	ADL

Comments:

For analytical results below detection limits:

Run samples are treated as the entire value of the MDL in calculations.

Reagent blank samples are treated as zero in calculations.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

☐ Draft Lab

USEPA Method 5/202 (FPM/CPM)
Gravimetric Laboratory Data Summary for CPM

Run No.		Field Blank	1	2	3
Date (2014)			Mar 18	Mar 18	Mar 19
Start Time (approx.)			10:45	17:56	09:14
Stop Time (approx.)			12:01	19:09	10:23
	Analytical Detection Limits				
MDL_i	Minimum detection limit for inorganic fraction (g)	0.00023			
MDL_o	Minimum detection limit for organic fraction (g)	0.00025			
	Inorganic Fraction				
	Water				
	Gravimetric Extraction Data				
ρ_i	Density (g/ml)	1.000			
V_{imp1}	Impinger 1 volume (mL)		176.7	172.9	171.7
V_{imp2}	Impinger 2 volume (mL)		40.7	20.6	9.9
V_{jr}	Jumper rinse volume (mL)		0.0	0.0	0.0
V_{ci}	Condensed moisture volume (mL)		217.4	193.5	181.6
V_{si}	Sample volume (mL)		664	442	565
V_{ai}	Aliquot volume (mL)	334	664	442	565
r_{ai}	Aliquot residue mass (g)	0.00133	0.00882	0.05011	0.00821
r_i	Inorganic sample residue mass (g)		0.00882	0.05011	0.00821
	Ammonium Titration Analysis				
pH	Sample initial pH	7.00	3.45	>4.5	3.44
N	Normality of titrant (meq/ml)	0.0556	0.0556	0.0556	0.0556
V_t	Volume of titrant added (mL)		0.30	0.00	0.30
m_c	Mass of NH_3 added to form ammonium sulfate (g)	0.00000	0.00028	0.00000	0.00028
$r_i - m_c$	Inorganic sample residue mass, less NH_3 mass (g)	0.00133	0.00854	0.05011	0.00793
	Organic Fraction				
	Acetone/Hexane				
	Gravimetric Extraction Data				
ρ_o	Density (g/ml)	0.701			
V_{so}	Sample volume (mL)		547	319	320
V_{ao}	Aliquot volume (mL)	332	547	319	320
r_{ao}	Aliquot residue mass (g)	0.00132	0.00210	0.00129	0.00106
r_o	Organic sample residue mass (g)		0.00210	0.00129	0.00106
m_{bi}	*Maximum Allowable Inorganic Blank Correction (g)*		0.00100	0.00099	0.00100
m_{ri}	*Net Inorganic Residue (g)*		0.00753	0.04912	0.00692
m_{CPMi}	*Total Inorganic CPM (g)*		0.00753	0.04912	0.00692
m_{bo}	*Maximum Allowable Organic Blank Correction (g)*		0.00100	0.00100	0.00100
m_{ro}	*Net Organic Residue (g)*		0.00110	0.00029	0.00006
m_{CPMo}	*Total Organic CPM (g)*		0.00110	0.00029	0.00025
m_T	*Total Gravimetric Result (g)*		0.00864	0.04941	0.00717
MDL_C	*Minimum Detection Limit for Combined Fractions (g)*		0.00048	0.00048	0.00048
m_{CPM}	*Total CPM (g)*		0.00864	0.04941	0.00717
n_{MDL}	*Number of Non-Detectable Fractions*		N/A	N/A	N/A
DLC	*Detection Level Classification*		ADL	ADL	ADL

Comments:

[1] Optional analytical step to stabilize inorganic residue; only performed if sample pH < 4.5.

For analytical results below detection limits:

Run samples are treated as the entire value of the MDL in calculations.

Reagent blank samples are treated as zero in calculations.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Stack

USEPA Method 5/202 (FPM/CPM)
Gravimetric Laboratory Data Summary for FPM

Run No. ☐ Draft Lab Data		Blank	4	5	6
Date (2014)			Mar 19	Mar 19	Mar 19
Start Time (approx.)			11:23	13:27	15:31
Stop Time (approx.)			12:32	14:38	16:41
	Analytical Detection Limits				
MDL_f	Minimum detection limit for filter (g)	0.00020			
MDL_s	Minimum detection limit for solvent rinse (g)	0.00025			
	Filter(s)				
m_{f1}	Filter No. 1 residue mass (g)		0.01789	0.01850	0.01864
m_{filter}	*Total filter residue (g)*		0.01789	0.01850	0.01864
	First Solvent Rinse				
	Acetone				
ρ_1	*Density (g/mL)*	0.785			
v_{s1}	Sample volume (mL)		103	95	92
v_{a1}	Aliquot volume (mL)	206	103	95	92
r_{a1}	Aliquot residue mass (g)	ND	0.00224	0.00169	0.00169
r_{s1}	Sample residue mass (g)		0.00224	0.00169	0.00169
m_{b1}	Allowable blank correction (g)		0.00000	0.00000	0.00000
m_1	*Net residue mass (g)*		0.00224	0.00169	0.00169
m_s	*Total Solvent Residue (g)*		0.00224	0.00169	0.00169
m_T	*Total Gravimetric Result (g)*		0.02013	0.02019	0.02033
m_D	*Total Gravimetric Detection Limit g)*		0.00045	0.00045	0.00045
m_n	*Total Filterable Particulate Matter (g)*		0.02013	0.02019	0.02033
n_{MDL}	*Number of Non-Detectable Fractions*		N/A	N/A	N/A
DLC	*Detection Level Classification*		ADL	ADL	ADL

Comments:

For analytical results below detection limits:

Run samples are treated as the entire value of the MDL in calculations.

Reagent blank samples are treated as zero in calculations.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Stack

USEPA Method 5/202 (FPM/CPM)
Gravimetric Laboratory Data Summary for CPM

☐ Draft Lab Data

Run No.		Field Blank	4	5	6
Date (2014)			Mar 19	Mar 19	Mar 19
Start Time (approx.)			11:23	13:27	15:31
Stop Time (approx.)			12:32	14:38	16:41
	Analytical Detection Limits				
MDL_i	Minimum detection limit for inorganic fraction (g)	0.00023			
MDL_o	Minimum detection limit for organic fraction (g)	0.00025			
	Inorganic Fraction				
	Water				
	Gravimetric Extraction Data				
ρ_i	Density (g/ml)	1.000			
V_{imp1}	Impinger 1 volume (mL)		171.2	148.1	178.8
V_{imp2}	Impinger 2 volume (mL)		4.7	6.0	1.2
V_{jr}	Jumper rinse volume (mL)		0.0	0.0	0.0
V_{ci}	Condensed moisture volume (mL)		175.9	154.1	180.0
V_{si}	Sample volume (mL)		585	625	616
V_{ai}	Aliquot volume (mL)	334	585	625	616
r_{ai}	Aliquot residue mass (g)	0.00133	0.00583	0.00757	0.00515
r_i	Inorganic sample residue mass (g)		0.00583	0.00757	0.00515
	Ammonium Titration Analysis				
pH	Sample initial pH	7.00	3.53	3.53	3.61
N	Normality of titrant (meq/ml)	0.0556	0.0556	0.0556	0.0556
V_t	Volume of titrant added (mL)		0.25	0.30	0.10
m_c	Mass of NH_3 added to form ammonium sulfate (g)	0.00000	0.00024	0.00028	0.00009
$r_i - m_c$	Inorganic sample residue mass, less NH_3 mass (g)	0.00133	0.00559	0.00729	0.00506
	Organic Fraction				
	Acetone/Hexane				
	Gravimetric Extraction Data				
ρ_o	Density (g/ml)	0.701			
V_{so}	Sample volume (mL)		393	380	367
V_{ao}	Aliquot volume (mL)	332	393	380	367
r_{ao}	Aliquot residue mass (g)	0.00132	0.00126	0.00119	0.00140
r_o	Organic sample residue mass (g)		0.00126	0.00119	0.00140
m_{bi}	*Maximum Allowable Inorganic Blank Correction (g)*		0.00100	0.00100	0.00100
m_{ri}	*Net Inorganic Residue (g)*		0.00459	0.00628	0.00405
m_{CPMi}	*Total Inorganic CPM (g)*		0.00459	0.00628	0.00405
m_{bo}	*Maximum Allowable Organic Blank Correction (g)*		0.00100	0.00100	0.00100
m_{ro}	*Net Organic Residue (g)*		0.00026	0.00019	0.00040
m_{CPMo}	*Total Organic CPM (g)*		0.00026	0.00025	0.00040
m_T	*Total Gravimetric Result (g)*		0.00485	0.00653	0.00446
MDL_C	*Minimum Detection Limit for Combined Fractions (g)*		0.00048	0.00048	0.00048
m_{CPM}	*Total CPM (g)*		0.00485	0.00653	0.00446
n_{MDL}	*Number of Non-Detectable Fractions*		N/A	N/A	N/A
DLC	*Detection Level Classification*		ADL	ADL	ADL

Comments:

[1] Optional analytical step to stabilize inorganic residue; only performed if sample pH < 4.5.

For analytical results below detection limits:

Run samples are treated as the entire value of the MDL in calculations.

Reagent blank samples are treated as zero in calculations.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

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LABORATORY ANALYSIS OF PARTICULATE MATTER
Laboratory Services Report No: 64-29078_GRAV_V0

Performed for:
CLEAN AIR ENGINEERING'S PALATINE SOURCE TESTING
500 West Wood St
Palatine IL, 60067

Pertaining to a Field Sampling Project Performed for :
MARATHON PETROLEUM COMPANY

Customer Reference No: 12461
Laboratory Services Project No: 29078
Revision 0: 04/01/14

To the best of our knowledge, the laboratory report nor the results provided have in any way been reproduced or altered except in full without prior written approval of the lab. The laboratory results presented in this report are accurate, complete, error free, legible and representative of the samples per the analysis described here-in. The lab retains the unaltered final copy for comparison purposes upon request.

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REVISION HISTORY

LABORATORY ANALYSIS OF PARTICULATE MATTER
Laboratory Services Report No: 64-29078_GRAV_V0

FINAL REPORT REVISION HISTORY

Revision:	Date	Pages	Comments
0	04/01/14	All	Final version of original document.

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CERTIFICATE OF ANALYSIS

1-1

Method (1) U.S. EPA Method 5 *SampleType* *(1) F1/2 Filter*

Location	*SampleID*	*Run*	*Volume (mL)*	*Net (g)*		*MDL (g)*
FCCU Regenerator Vent	29078-001	1		0.00576		0.00020
FCCU Regenerator Vent	29078-002	2		0.01799		0.00020
FCCU Regenerator Vent	29078-003	3		0.01510		0.00020
FCCU Regenerator Vent	29078-004	4		0.01789		0.00020
FCCU Regenerator Vent	29078-005	5		0.01850		0.00020
FCCU Regenerator Vent	29078-006	6		0.01864		0.00020

Method (1) U.S. EPA Method 5 *SampleType* *(2) F1/2 Acetone Rinse*

Location	*SampleID*	*Run*	*Volume (mL)*	*Net (g)*		*MDL (g)*
All	29078-007	FRB	206	<		0.00025
All	29078-008	FRB	189	<		0.00025
FCCU Regenerator Vent	29078-009	1	112	0.00312		0.00025
FCCU Regenerator Vent	29078-010	2	107	0.03915	B	0.00025
FCCU Regenerator Vent	29078-010a	2	107	0.00243	B	0.00025
FCCU Regenerator Vent	29078-011	3	87	0.00496		0.00025
FCCU Regenerator Vent	29078-012	4	103	0.00224		0.00025
FCCU Regenerator Vent	29078-013	5	95	0.00169		0.00025
FCCU Regenerator Vent	29078-014	6	92	0.00169		0.00025

Method (7) U.S. EPA Method 202 *SampleType* *(6) B1/2 Acetone Rinse*

Location	*SampleID*	*Run*	*Volume (mL)*	*Net (g)*		*MDL (g)*
All	29078-015	FRB	207	0.00036	A	0.00025

A: The net weights are considered to be readily quantifiable, therefore these values are believed to be accurate. But the weights fall below the Method Reporting Limit (MRL) value of 0.5mg. These net weights should probably be used with some discretion.
B: This sample contained a foreign object. The original weight is reported, and the corrected weight if available is shown with the sample ID suffix 'a'. See narrative for discussion.

CERTIFICATE OF ANALYSIS

1-2

Method (7) U.S. EPA Method 202 *SampleType* *(7) B1/2 Inorganic Rinse*

Location	*SampleID*	*Run*	*Volume (mL)*	*Net (g)*		*MDL (g)*
All	29078-016	FRB	219	0.00070		0.00023
All	29078-017	FTRB	334	0.00133		0.00023
FCCU Regenerator Vent	29078-018	1	664	0.00882		0.00023
FCCU Regenerator Vent	29078-019	2	442	0.05011		0.00023
FCCU Regenerator Vent	29078-020	3	565	0.00821		0.00023
FCCU Regenerator Vent	29078-021	4	585	0.00583		0.00023
FCCU Regenerator Vent	29078-022	5	625	0.01237	B	0.00023
FCCU Regenerator Vent	29078-022a	5	625	0.00757	B	0.00023
FCCU Regenerator Vent	29078-023	6	616	0.00515		0.00023

Method (7) U.S. EPA Method 202 *SampleType* *(8) B1/2 Organic Rinse*

Location	*SampleID*	*Run*	*Volume (mL)*	*Net (g)*	*MDL (g)*
All	29078-024	FRB	267	<	0.00025
All	29078-025	FTRB	332	0.00132	0.00025
FCCU Regenerator Vent	29078-026	1	547	0.00210	0.00025
FCCU Regenerator Vent	29078-027	2	319	0.00129	0.00025
FCCU Regenerator Vent	29078-028	3	320	0.00106	0.00025
FCCU Regenerator Vent	29078-029	4	393	0.00126	0.00025
FCCU Regenerator Vent	29078-030	5	380	0.00119	0.00025
FCCU Regenerator Vent	29078-031	6	367	0.00140	0.00025

End of Section 1 – Certificate of Analysis

A: The net weights are considered to be readily quantifiable, therefore these values are believed to be accurate. But the weights fall below the Method Reporting Limit (MRL) value of 0.5mg. These net weights should probably be used with some discretion.
B: This sample contained a foreign object. The original weight is reported, and the corrected weight if available is shown with the sample ID suffix 'a'. See narrative for discussion.

ANALYTICAL CASE NARRATIVE

INTRODUCTION

Clean Air Engineering's Palatine Source Testing (the Customer) contracted Clean Air Engineering's Laboratory Services (the Lab) to determine the following:

- Filterable Particulate matter
- Condensable Particulate matter

All analyses were performed on samples received by the Lab at their facility in Palatine, IL. All analyses were performed in accordance with the applicable EPA Method requirements along with all NELAP quality requirements as outlined and described in Section 3 of this report.

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Key Project Participants

Samples were received at the Lab's facility on 03/25/14. The following is a table of key personnel involved with this project:

Table 2-2:
Pertinent Participants

Personnel	Affiliation	Function
S Lehmann	Customer	Custody Relinquished
M Tuegel	Lab	Sample Reciept
M Tuegel	Lab	Lead Analyst
S Lehmann	Customer	Project Manager

Accreditation

The Lab is accredited through the following state agencies.

Table 2-3:
Specific Accreditations and Expiration Dates

State	Certificate Number	Expiration Date
Texas	T104704431-13-4	8/31/2014
New Jersey	IL004	6/30/2014
Louisiana	169249	6/30/2014

Further information is available at the respective state websites regarding our current accreditation status and a comprehensive list of our accredited services.

DISCUSSION OF ANALYTICAL RESULTS

Table 2-4 shown below, presents the average amounts of particulate matter found for each sample fraction. Also shown are the standard deviations (SD) and percent relative standard deviations (RSD). These data are not corrected for plant conditions or sampling volumes.

Table 2-4:
Statistical Description of the Filterable Particulate Matter Catches.

Method	Location	Matrix	Average Net Weight (mg)	SD of Net Weights (mg)	RSD of Net Weights (%)
U.S. EPA Method 5	FCCU Regenerator Vent				
		F1/2 Filter	15.65	5.01	32%
		F1/2 Acetone Rinse	8.81	14.91	169%
		Total FPM	24.46	16.64	68%
U.S. EPA Method 202	FCCU Regenerator Vent				
		B1/2 Inorganic Rinse	15.08	17.35	115%
		B1/2 Organic Rinse	1.38	0.37	27%
		Total CPM	16.47	17.31	105%

The method 5 F1/2 acetone rinse run 2 (29078-010) and method 202 B1/2 inorganic rinse run 5 (29078-022) from the FCCU Regenerator Vent location contained a foreign object believed to be a piece of glass. A final weight was attained with the foreign object inside the sample. The object was then rinsed and removed then reanalyzed. It is the laboratory's opinion that the weight without the object is the most representative of sampling conditions during that run. Both weights are given on the certificate of analysis

Reported net weights for Inorganic rinses are not corrected for the amount of ammonium hydroxide added during the acidic component neutralization step. The correction values are given on the titration page in Appendix II.

A representative selection of sample photographs is shown in Figure 2-1 through Figure 2-2 on the next few pages. These photographs illustrate the condition of the samples and the residue contained therein. A photographic record of samples is contained in Appendix III.

Figure 2-1: Photograph Illustrating the Residue Found in Laboratory Sample No: 29078-010.

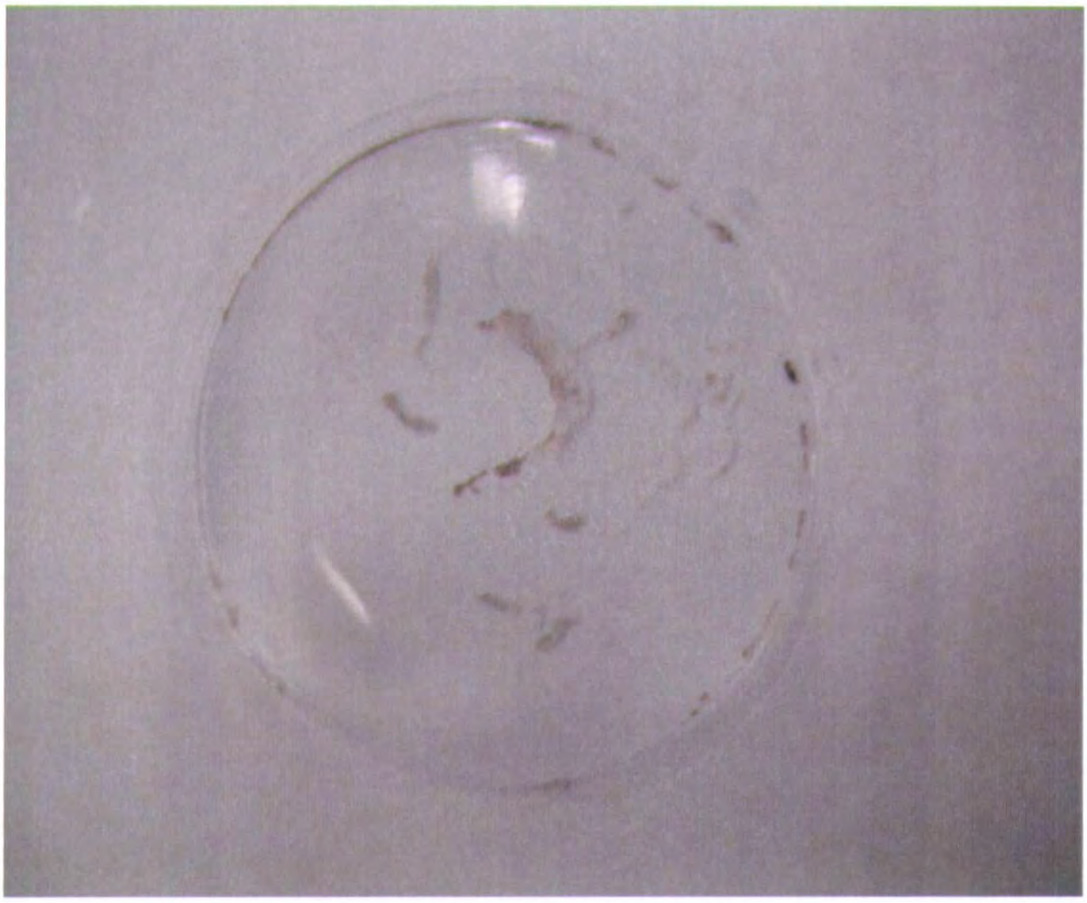
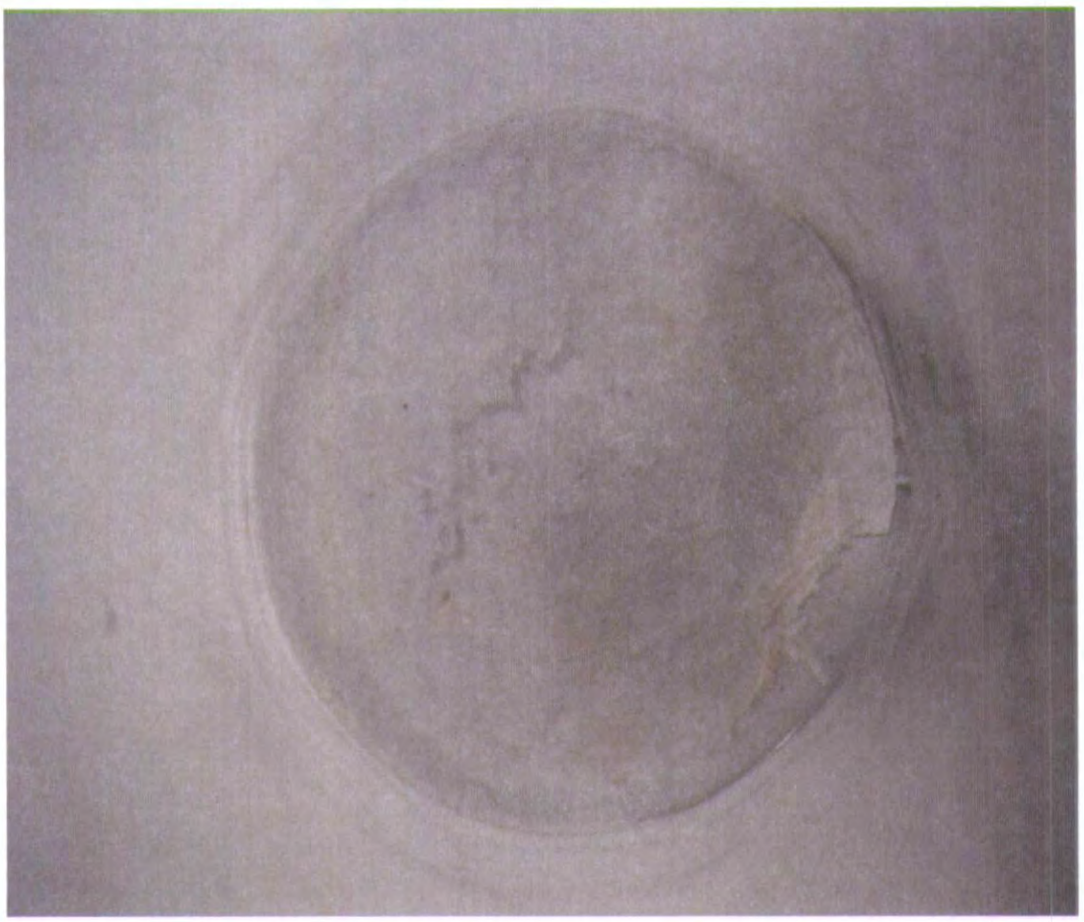


Figure 2-2: Photograph Illustrating the Residue Found in Laboratory Sample No: 29078-019.



End of Section 2 – Analytical Case Narrative

METHODOLOGY

3-1

Table 3-2, below summarizes the reference methods to the analytical procedures performed and their respective sources.

Table 3-2:
List of Analytical Methodology

Title 40 CFR Part 60 Appendix A	
Method 5	"Determination of Particulate Matter Emissions from Stationary Sources"
Title 40 CFR Part 51 Appendix M	
Method 202	"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"

US EPA methods appear in detail in Title 40 of the Code of Federal Regulations (CFR) and are located on the internet at http://www.epa.gov/ttn/emc/ .

The Lab followed specific quality assurance and quality control (QA/QC) procedures as outlined in the individual methods and as prescribed in Laboratory Services' internal Quality Manual. Results of recorded QA/QC activities performed by Laboratory Services are summarized in Appendix IV.

Sample Preparation

EPA Method 5

Filter Catches

1 Placed in a desiccator for a minimum of twenty-four hours prior to analysis.

Front Half Probe Rinses

1 Quantitatively transferred into a clean, individually numbered and tared Teflon® beaker liner.
2 Evaporated under a hood at ambient conditions.
3 Any residual moisture was heated at 60°C for a minimum of 6 hours.
4 Placed in a desiccator for a minimum of twenty-four hours prior to analysis.

Accreditation Through (As of reported date)

1 Texas (TCEQ)
2 New Jersey (NJDEP)
3 Louisiana (LELAP)

EPA Method 202

CPM Filter

1 Carefully folded and placed into a 40 mL (VOA) vial
2 Added sufficient DI water to the vial to cover the filter
3 The VOA vial was loaded into a proprietary flotation device and placed into a ultrasonic bath for a minimum of 2 minutes
4 This was repeated twice more for a total of three extractions, these extractions are combined with the back half inorganic rinse
5 Added sufficient Hexane to the vial to cover the filter
6 The VOA vial was loaded into a proprietary flotation device and placed into an ultrasonic bath for a minimum of 2 minutes
7 This was repeated twice more for a total of three extractions, threes extractions are combined with the back half organic rinse

Inorganic Rinse

1. Sample pH was measured
2. Sample was combined with 3 additional DI water rinses used to extract
3. The sample was extracted three times in a seperatory funnel with Hexane
    a. The solution was well mixed prior to the removal of the added Hexane
    b. Care was taken to ensure that no water exits the funnel upon draining the Hexane
4. Quantitatively transferred into a clean, individually numbered and tared Teflon® beaker liner
5. Evaporated in an oven at 105C until just prior to dryness and evaporated fully at ambient temperature

METHODOLOGY

3-3

6. If the initial sample pH was 4.50 or less, then the sample was redissolved with 100 mL of deionized water, neutralized using ammonium hydroxide as a titrant
    a. This is an alteration to U.S. EPA Method 202 which states that an attempt to attain a constant weight should be tried before the sample is titrated. Documentation showing the validity of this deviation is available upon request.
    b. Any sample that has a starting pH of greater than or equal to 7 will not be titrated
7. Evaporated in an oven at 105C until just prior to dryness and evaporated fully at ambient temperature.
8. Placed in a desiccator for a minimum of twenty-four hours prior to analysis.

Organic Rinse

1. Samples combined with 3 additional Hexane rinses used to extract Inorganic Rinse
2. Sample combined with 3 additional Hexane rinses used to extract CPM Filter
3. Quantitatively transferred into a clean, individually numbered and tared Teflon® beaker liner
4. Evaporated under a hood at ambient conditions
5. Placed in a desiccator for a minimum of twenty-four hours prior to analysis

Accreditation Through (As of reported date)

1 Texas (TCEQ)
2 New Jersey (NJDEP)
3 Louisiana (LELAP)

Analytical Procedures Common To All Methods

Equipment Calibrations

- Each analytical balance was calibrated and certified as accurate by an ISO 17025 calibration service on annual basis. A copy of this calibration data is available on request.
- All equipments used in relation to this analysis have been properly calibrated. Any calibration data is available upon request.
- Each balance is calibrated prior to use on a daily basis using a minimum of three annually certified Class 1 weights:
  a. 200 mg
  b. 500 mg
  c. 5 g
- These daily calibrations must match the Class 1 weight values within ±0.2 mg in order to proceed.
- Periodic calibrations are also performed throughout the day.
- Appendix VII provides a copy of pertinent daily balance calibration data. All data is provided in grams. Further data including the serial number and calibration sheet for weights used are available upon request.

Sample Volumes

- The Certificate of Analysis page shows the total volume evaporated by the laboratory, including rinses with laboratory reagents.
- The Certificate of Analysis page shows volumes calculated from the gravimetrically obtained value.
  - Volume conversions assumed standard temperature (20°C) and pressure (1 atm).
  - The exact laboratory temperature over the course of this analysis is available upon request
- Liquid density values used for volume conversion calculations are referenced from page 15-25 of the CRC Handbook, 91st Edition:
  - Water: 0.9982 g/mL
  - Acetone: 0.7902 g/mL
  - Hexane: 0.6594 g/mL
- Appendix VIII provides data pertaining to specific volumes added to the sample by the laboratory. All volume data presented are in grams.

Sample Chain of Custody

- Appendix V provides data pertaining to custody from the samples creation in the field through the sample analysis.
- Customer custody documents are provided with laboratory sample number recorded to provide a link from laboratory data to customer recorded data.
- The date and time for evaporation and analysis by the Lab is also provided. This data includes the start time of; evaporation, any secondary evaporation, and at least two weights.

Sample Analysis

- A Teflon® FEP beaker liner was used for the analysis of all liquid fractions. Throughout this report they will be referred to as Teflon® beaker liners. "Teflon" is a registered trademark of DuPont.
- Each sample is removed from the desiccator using tweezers and placed on the balance pan after an initial 24 hours of desiccation.
- Sample weights were computer recorded using the laboratory's proprietary data acquisition system.
- Samples were placed back into the desiccator for a minimum of six hours before the next weight was measured.
- This continued until a constant weight was attained.
    - Constant weight: A difference of no more than 0.5 mg or one percent of total weight less tare weight whichever is greater, between two consecutive weights, with no less than six hours of desiccation time between weights.
- The final weight acquired meeting the above criteria is used for the final weight, all weights reported are net weights.
    - Net weights are calculated from the final tare weight and the final gross weight attained.
    - Net weights reported for liquid samples represent the residue left after total evaporation.
    - Net weights reported for filter samples represent the particulate caught in and on the filter.

Sample Quality Control

Reagent Purity

- All the lot numbers of any chemical used during this analysis was recorded. This information is available upon request.
- All solvents used are at minimum ACS Certified reagent grade chemicals.
- All prepared chemicals were prepared from chemicals that were at a minimum ACS Certified reagent grade.

Tare Weight Check

- For a final tare weight to be considered, it must agree within 0.5 mg (or 1% of the net weight, whichever is greater) of the previously recorded weight for that media. Until this condition is met, the tared media is not used.
- A minimum of three tare weights are acquired on Teflon® beaker liners to show a minimal effect of static. All three tare weights must be within 0.5mg of each other.
- Appendix III shows all tare weights acquired for the media used.

Gross Weight Check

- For a final sample weight to be considered, it must agree within 0.5 mg (or 1% of the net weight, whichever is greater) of the previously recorded weight for that sample.
- Appendix III shows all sample weights acquired for the media used.
- Appendix IV provides a summary of the weight difference for weights used to calculate the net weight. The sample number is provided for a reference to link data provided on the certificate of analysis.

Weight Time Check

- Each sample's respective tare and gross weights are acquired with a minimum desiccation time of six hours between consecutive weights.
- Appendix IV provides a summary of the time difference in hours for gross weights used to calculate the net weight. The sample number is provided for a reference to link data provided on the certificate of analysis.

Environmental / Weight Effects

- For every analysis period per matrix, a matrix blank, and a matrix spike is created to ensure that no effect from either the laboratory environment or chemical has adversely affected the results of the measurement.

Minimum Detection Limit

Summary Data

- Appendix VI provides a summary report broke down by matrix type
- Detection limit was calculated by finding the standard deviation of a pool of data from spiked samples of a given matrix type collected by the lab. This standard deviation is than multiplied by the proper Student-T value associated with the number of iterations present in the pool.

Blank Sample Data

- Appendix VI provides data for blank samples analyzed pertaining to the period when the samples were analyzed. Further data is available upon request.

Spike Sample Data

- Appendix VI provides data for spike samples analyzed pertaining to the period when the samples were analyzed. Further data is available upon request.

Project Archival

- A copy of this report and all associated supporting records will be archived and stored for at least 20 years.
- All samples are archived for a period of one year from the date of receipt in our facility.
- The archival facility is a controlled access storage facility that does not incorporate any environmental controls.
- Gravimetrics samples are archived in the following manner:
    - All filters are stored inside the originally provided Petri-dishes;
    - All other residues are stored within the Teflon® beaker liner in which they were evaporated to dryness.
    - These Teflon® beaker liners are sealed inside a polyethylene sample container (cup) prior to archival

Reporting Abbreviations

1 FRB: Field Reagent Blank
2 FTRB: Field Train Reagent Blank
3 FTP: Train Proof
4 F1/2: Front Half
5 B1/2: Back Half

End of Section 3 – Methodology

APPENDIX

4-1

SAMPLE CALCULATIONS I
SAMPLE TITRATION DATA II
RAW DATA III
QUALITY ASSURANCE RECORDS IV
CHAIN-OF-CUSTODY DOCUMENTATION V
DETECTION LIMIT DETERMINATION DATA VI
EQUIPMENT CALIBRATION RECORDS VII
SAMPLE VOLUME DATA VIII

SAMPLE CALCULATIONS

Sample Calculations

1. **Determination of sample tare weight.**

$$TW_S = TW_{Final}$$

Variable	Description	Example
TW_S	Tare weight of sample (g)	0.38848
TW_{Final}	Final Tare weight of consecutive weights (g)	0.38848

2. **Determination of difference between two consecutive weights (sample tare weight).**

$$TW_{Difference} = 1000|TW_2 - TW_1|$$

Variable	Description	Example
$TW_{Difference}$	Difference between two consecutive tare weights (mg)	0.10
$TW_{Trial\ 2}$	Tare weight Trial 1 of consecutive weights (g)	0.38858
$TW_{Trial\ 1}$	Tare weight Trial 1 of consecutive weights (g)	0.38848
1000	Constant (mg/g)	1000

3. **Determination of sample gross weight.**

$$GW_S = GW_{Final}$$

Variable	Description	Example
GW_S	Gross weight of sample (g)	0.48065
GW_{Final}	Final Gross weight of consecutive weights (g)	0.48065

4. **Determination of difference between two consecutive weights (sample gross weight).**

$$GW_{Difference} = 1000|GW_2 - GW_1|$$

Variable	Description	Example
$GW_{Difference}$	Difference between two consecutive Gross weights (mg)	0.10
$GW_{Trial\ 2}$	Gross weight Trial 2 of consecutive weights (g)	0.38848
$GW_{Trial\ 1}$	Gross weight Trial 1 of consecutive weights (g)	0.38858
1000	Constant (mg/g)	1000

Sample Calculations

5. Determination of sample net weight.

$$NW_S = GW_S - TW_S$$

Variable	Description	Example
NW_S	Net weight of sample (g)	0.09217
GW_S	Gross weight of sample (g)	0.48065
TW_S	Tare weight of sample (g)	0.38848

6. Determination of Method Determination Limits (MDL) for filters.

a. Determination of spike amount of residue added (total mg).

$$RA = \frac{(SA)(SSC)}{1000}$$

Variable	Description	Example
RA	Amount of spike residue added (g)	0.00101
SSC	Spike solution concentration (mg/ml)	2.01
SA	Amount of spike solution added to filter (ml)	0.5
1000	Constant (mg/g)	1000

b. Determination of average spike results.

$$AvgM_{f\_i} = \frac{\sum_{i=1}^{n} M_{f\_i}}{n}$$

Variable	Description	Example
$AvgM_{f\_i}$	Average of spike result net weights (mg)	1.08
M_{f_i}	Net weights recorded for each iteration (mg)	1.08
n	Number of iterations	10
i	Placeholder for iteration	1

c. Determination of standard deviation of spike results.

$$\sigma_{f\_i} = \sqrt{\frac{\sum_{i=1}^{n}(M_{f\_i} - AvgM_{f\_i})^2}{(n-1)}}$$

Variable	Description	Example
σ_{f_i}	Standard deviation of spike results	0.08
$AvgM_{f\_i}$	Average of spike result net weights (mg)	1.08
M_{f_i}	Net weights recorded for each iteration (mg)	1.08
n	Number of iterations	10
i	Placeholder for iteration	1

Sample Calculations

d. Determination of average spike recovery.

$$R_F = \frac{AvgM_{f\_i}}{RA} 100$$

Variable	Description	Example
R_F	Average spike recovery (%)	107.4%
$AvgM_{f\_i}$	Average of spike result net weights (mg)	1.08
RA	Amount of spike residue added (mg)	1.01
100	Conversion constant (fraction to percent)	100

e. Determination of $t_{(n-1, 0.99)}$.

n	$t_{(n-1,0.99)}$
7	3.143
8	2.998
9	2.896
10	2.821
11	2.764
16	2.602
21	2.528

Variable	Description	Example
$t_{(n-1,0.99)}$	Students' t-value appropriate for a 99% confidence (n-1) degrees of freedom	2.821
n	Number of iterations	10

f. Determination of Method Detection Limit (MDL).

$$MDL = \sigma_{f\_i} t_{(n-1,0.99)}$$

Variable	Description	Example
MDL	Method detection limit (g)	0.00023
$t_{(n-1,0.99)}$	Students' t-value appropriate for a 99% confidence (n-1) degrees of freedom	2.821
σ_{f_i}	Standard deviation of spike result.	0.08083

Sample Calculations

7. Determination of volume (mL) from sample mass (g)

$$V_{mL} = \frac{M_{Sample}}{D_{Liquid}}$$

Variable	Description	Example
V_{mL}	Volume of sample (mL)	252
M_{Sample}	Sample mass (g)	199.0
D_{Liquid}	Density of Deionized Water Liquid (g/mL)	0.9982

8. Determination of N_t for Acidic Component Neutralization

$$N_T = \frac{V_S N_S}{V_T}$$

Variable	Description	Example
N_T	Normality of titrant	0.0552
V_S	Volume of standard used	20.0
N_S	Normality of standard used	0.02
V_T	Volume of titrant used	7.25

9. Determination of Mass of ammonia correction

$$M_C = 17.03 \times V_t \times N_T$$

Variable	Description	Example
M_C	Mass of the NH_4^+ added to sample to form ammonium sulfate (mg).	0.42
V_T	Volume of NH_4OH titrant (ml).	0.45
N_T	Normality of ammonium hydroxide titrant.	0.0552
17.03	mg/milliequivalents for ammonium ion	17.03

10. Determination of Corrected Back half inorganic value

$$M_I = M_R - M_C$$

Variable	Description	Example
M_I	Mass of inorganic CPM (mg).	5.47
M_R	Mass of dried sample from inorganic fraction (mg).	5.89
M_C	Mass of the NH_4^+ added to sample to form ammonium sulfate (mg).	0.42

Sample Calculations

11. Determination of the Concentration for Sample and Quality Checks

$$C_f = \frac{M_S}{V_M}$$

Variable	Description	Example
M_S	Mass of spike added (mg).	0.18
V_M	Volume of matrix added (g)	225.69
C_F	Concentration for Sample and Quality Checks (mg/g)	0.00080

12. Determination of the Net(w/v) Corrected

$$N_{(W/V)\_C} = N_{(W/V)} - C_B$$

Variable	Description	Example
$N_{(W/V)}$	Net(W/V) Concentration (mg/g).	0.00538
C_B	Concentration of appropriate matrix blank (mg/g)	0.00046
$N_{(W/V)\_C}$	Concentration for the Net(W/V) Corrected (mg/g)	0.00492

13. Determination of the Average Blank Concentration

$$C_{B\_avg} = \frac{\sum_{i=1}^{n} C_{B\_i}}{n}$$

Variable	Description	Example
C_{B_avg}	Concentration of each blank for each iteration (mg/g)	0.00046
C_{B_i}	Concentration of each blank for each iteration (mg/g)	0.00040
n	Number of Iterations	80

14. Determination of Corrected Net(w/v)

$$N_{w\_c} = (V_M)(N_{(W/V)\_c})$$

Variable	Description	Example
$N_{(W/V)\_c}$	Concentration for the Net(W/V) Corrected (mg/g)	0.00492
V_M	Volume of matrix added (g)	425.40
N_{w_c}	Corrected Net(W/V) (mg)	2.09

SAMPLE TITRATION DATA

II

Titrimetric Neutralization Data

Sample Type	Date	Time	Starting pH	Ending pH	Titrant Used (mL)	Nt	Technician
Calibration	3/28/2014	8:15	2.29	7.08	7.20	0.0556	mtuegel

Sample ID	Date	Time	Initial pH	Starting pH	Ending pH	Titrant Used (mL)	Correction (mg)	Technician
29078-018	3/28/2014	8:24	3.45	3.21	7.15	0.30	0.28	mtuegel
29078-020	3/28/2014	8:27	3.44	3.11	7.14	0.30	0.28	mtuegel
29078-021	3/28/2014	8:32	3.53	3.24	7.15	0.25	0.24	mtuegel
29078-022	3/28/2014	8:37	3.53	3.17	7.13	0.30	0.28	mtuegel
29078-023	3/28/2014	8:42	3.61	3.48	7.11	0.10	0.09	mtuegel

RAW DATA

III

Raw Gravimetric Data

Sample ID:	29078-001	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(1) F1/2 Filter
Run No:	1	*Recovery Date:*	3/18/2014
Field Tech:	JCM		

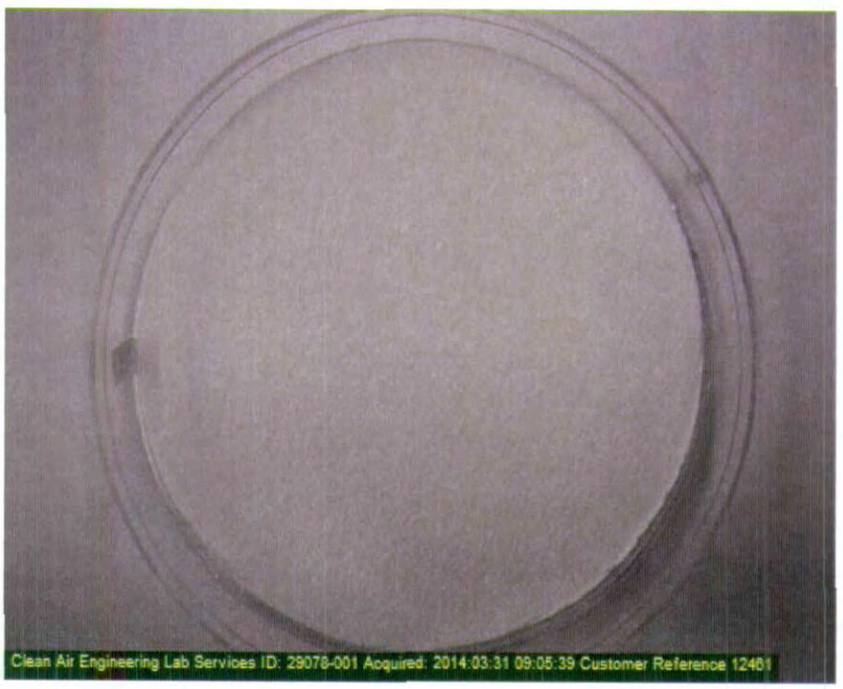
Media 1 ID: 45472

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
45472	1/23/2014	11:08	0.49330	mtuegel
45472	1/24/2014	12:34	0.49340	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
45472	3/27/2014	9:27	0.49911	mtuegel
45472	3/28/2014	10:11	0.49916	mtuegel



Sample ID:	29078-002	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(1) F1/2 Filter
Run No:	2	*Recovery Date:*	3/19/2014
Field Tech:	SL		

Media 1 ID: 45473

Media 1 Tared Weight Record

Media ID	Date	Time	Weight (g)	Technician
45473	1/23/2014	11:08	0.49803	mtuegel
45473	1/24/2014	12:34	0.49810	mtuegel

Sample Weight Record

Media ID	Date	Time	Weight (g)	Technician
45473	3/27/2014	9:32	0.51596	mtuegel
45473	3/28/2014	10:11	0.51609	mtuegel

Sample ID:	29078-003	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(1) F1/2 Filter
Run No:	3	*Recovery Date:*	3/19/2014
Field Tech:	SL		

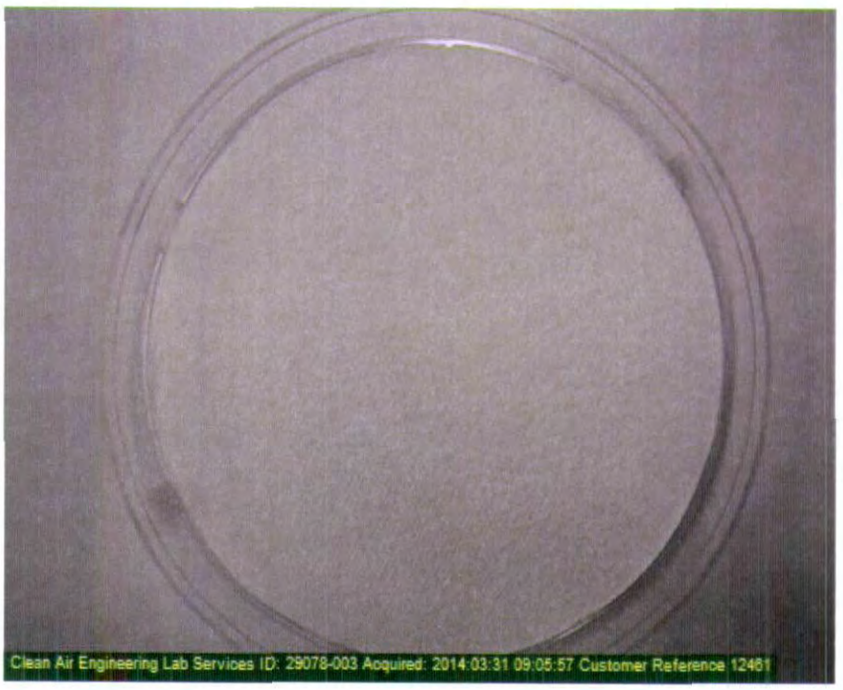
Media 1 ID: 45474

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
45474	1/23/2014	11:10	0.49787	mtuegel
45474	1/24/2014	12:37	0.49791	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
45474	3/27/2014	9:32	0.51287	mtuegel
45474	3/28/2014	10:11	0.51301	mtuegel



Sample ID:	29078-004	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(1) F1/2 Filter
Run No:	4	*Recovery Date:*	3/19/2014
Field Tech:	SL		

Media 1 ID: 45475

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
45475	1/23/2014	11:11	0.49779	mtuegel
45475	1/24/2014	12:37	0.49801	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
45475	3/27/2014	9:32	0.51582	mtuegel
45475	3/28/2014	10:05	0.51590	mtuegel

Sample ID:	29078-005	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(1) F1/2 Filter
Run No:	5	*Recovery Date:*	3/19/2014
Field Tech:	SL		

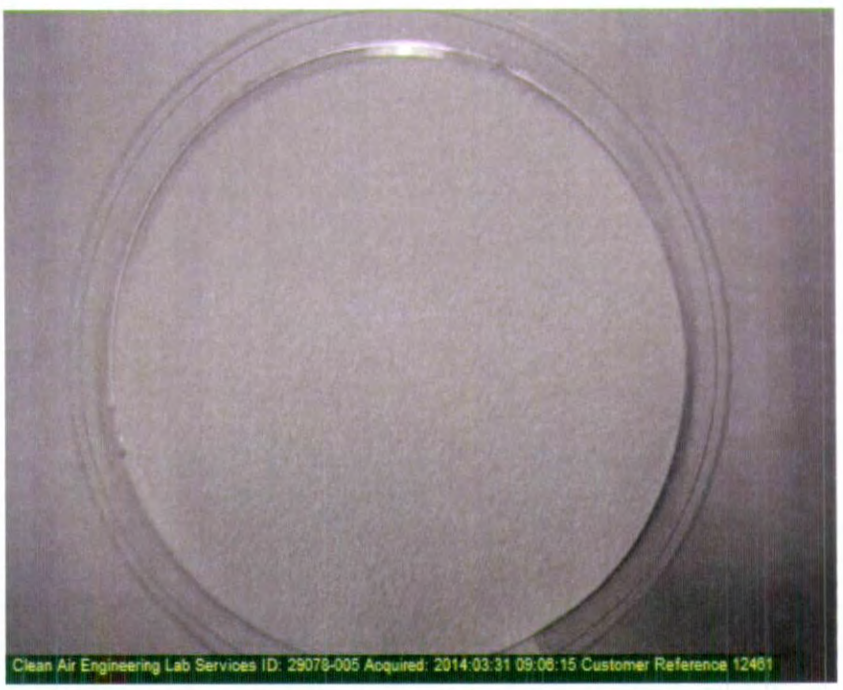
Media 1 ID: 45476

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
45476	1/23/2014	11:11	0.49968	mtuegel
45476	1/24/2014	12:37	0.49969	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
45476	3/27/2014	9:43	0.51804	mtuegel
45476	3/28/2014	10:05	0.51819	mtuegel



Sample ID:	29078-006	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(1) F1/2 Filter
Run No:	6	*Recovery Date:*	3/19/2014
Field Tech:	SL		

Media 1 ID: 45477

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
45477	1/23/2014	11:13	0.48745	mtuegel
45477	1/24/2014	13:05	0.48747	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
45477	3/27/2014	9:43	0.50596	mtuegel
45477	3/28/2014	10:04	0.50611	mtuegel

Sample ID:	29078-007	*Method:*	(1) U.S. EPA Method 5
Location:	All	*Sample Type:*	(2) F1/2 Acetone Rinse
Run No:	FRB	*Recovery Date:*	3/18/2014
Field Tech:	JCM		

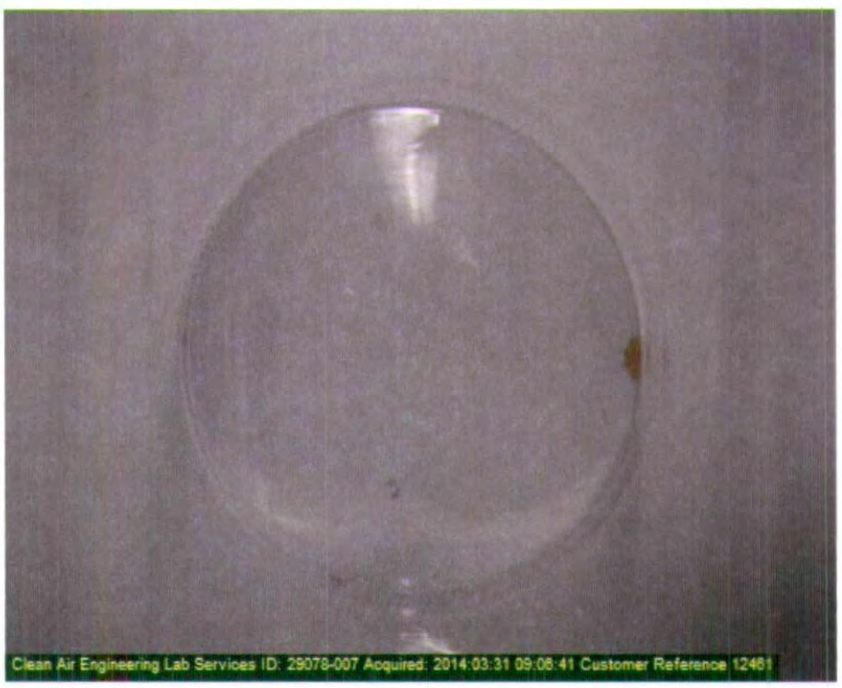
Media 1 ID: 13065

Media 1 Tared Weight Record

Media ID	Date	Time	Weight (g)	Technician
13065	2/6/2014	13:26	4.10323	mtuegel
13065	2/7/2014	13:33	4.10323	mtuegel
13065	2/10/2014	13:27	4.10317	mtuegel

Sample Weight Record

Media ID	Date	Time	Weight (g)	Technician
13065	3/28/2014	8:34	4.10330	mtuegel
13065	3/28/2014	15:16	4.10328	mtuegel



Sample ID:	29078-008	*Method:*	(1) U.S. EPA Method 5
Location:	All	*Sample Type:*	(2) F1/2 Acetone Rinse
Run No:	FRB	*Recovery Date:*	3/20/2014
Field Tech:	SL		

Media 1 ID: 13038

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13038	2/6/2014	13:26	4.12749	mtuegel
13038	2/7/2014	13:33	4.12750	mtuegel
13038	2/10/2014	13:40	4.12750	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13038	3/28/2014	8:39	4.12765	mtuegel
13038	3/28/2014	15:11	4.12768	mtuegel

Sample ID:	29078-009	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(2) F1/2 Acetone Rinse
Run No:	1	*Recovery Date:*	3/18/2014
Field Tech:	JCM		

Media 1 ID: 13069

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13069	2/6/2014	13:26	4.18815	mtuegel
13069	2/7/2014	13:33	4.18824	mtuegel
13069	2/10/2014	13:40	4.18810	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13069	3/28/2014	8:39	4.19120	mtuegel
13069	3/28/2014	15:11	4.19122	mtuegel

Sample ID:	29078-010	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(2) F1/2 Acetone Rinse
Run No:	2	*Recovery Date:*	3/19/2014
Field Tech:	SL		

Media 1 ID: 13023

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13023	2/6/2014	13:38	4.16691	mtuegel
13023	2/7/2014	13:26	4.16696	mtuegel
13023	2/10/2014	13:40	4.16695	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13023	3/28/2014	8:22	4.20614	mtuegel
13023	3/28/2014	15:39	4.20610	mtuegel

Sample ID:	29078-010a	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(2) F1/2 Acetone Rinse
Run No:	2	*Recovery Date:*	3/19/2014
Field Tech:			

Media 1 ID: 13023a

Media 1 Tared Weight Record

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13023a	3/31/2014	9:14	4.16913	mtuegel
13023a	3/31/2014	15:16	4.16937	mtuegel
13023a	4/1/2014	9:12	4.16938	mtuegel

Sample ID:	29078-011	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(2) F1/2 Acetone Rinse
Run No:	3	*Recovery Date:*	3/19/2014
Field Tech:	SL		

Media 1 ID: 13093

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13093	2/6/2014	13:43	3.99339	mtuegel
13093	2/7/2014	13:20	3.99340	mtuegel
13093	2/10/2014	13:47	3.99335	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13093	3/28/2014	8:34	3.99824	mtuegel
13093	3/28/2014	15:16	3.99831	mtuegel

Sample ID:	29078-012	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(2) F1/2 Acetone Rinse
Run No:	4	*Recovery Date:*	3/19/2014
Field Tech:	SL		

Media 1 ID: 13043

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13043	2/6/2014	13:38	4.15171	mtuegel
13043	2/7/2014	13:26	4.15189	mtuegel
13043	2/10/2014	13:47	4.15162	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13043	3/28/2014	8:34	4.15383	mtuegel
13043	3/28/2014	15:16	4.15386	mtuegel

Sample ID:	29078-013	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(2) F1/2 Acetone Rinse
Run No:	5	*Recovery Date:*	3/19/2014
Field Tech:	SL		

Media 1 ID: 13046

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13046	2/6/2014	13:43	4.21218	mtuegel
13046	2/7/2014	13:20	4.21216	mtuegel
13046	2/10/2014	13:51	4.21210	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13046	3/28/2014	8:17	4.21383	mtuegel
13046	3/28/2014	15:44	4.21379	mtuegel

Sample ID:	29078-014	*Method:*	(1) U.S. EPA Method 5
Location:	FCCU Regenerator Vent	*Sample Type:*	(2) F1/2 Acetone Rinse
Run No:	6	*Recovery Date:*	3/19/2014
Field Tech:	SL		

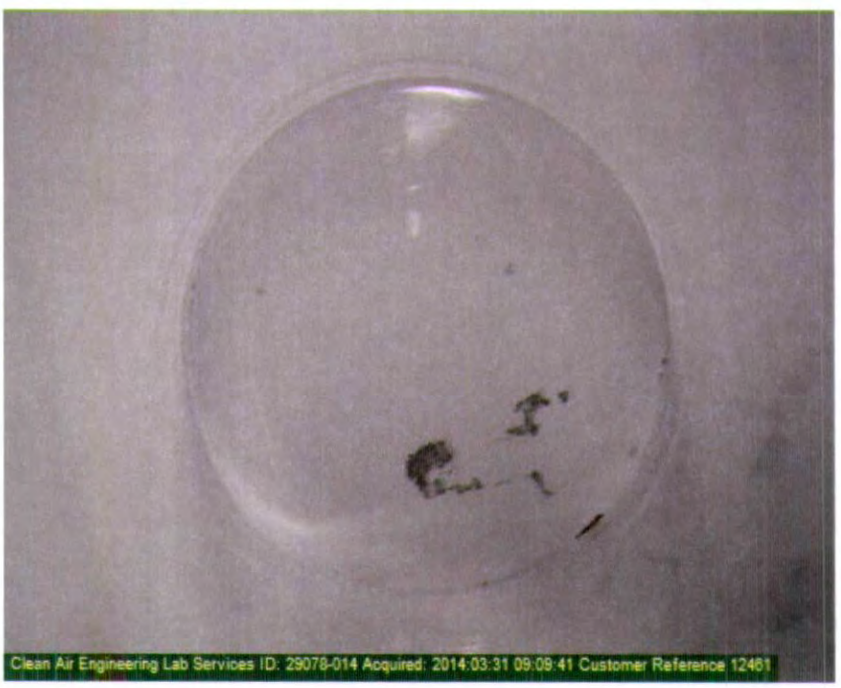
Media 1 ID: 13095

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13095	2/6/2014	13:43	4.16441	mtuegel
13095	2/7/2014	13:20	4.16455	mtuegel
13095	2/10/2014	13:51	4.16433	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13095	3/28/2014	8:22	4.16606	mtuegel
13095	3/28/2014	15:39	4.16602	mtuegel



Sample ID:	29078-015	*Method:*	(7) U.S. EPA Method 202
Location:	All	*Sample Type:*	(6) B1/2 Acetone Rinse
Run No:	FRB	*Recovery Date:*	3/18/2014
Field Tech:	JCM		

Media 1 ID: 13084

Media 1 Tared Weight Record

Media ID	Date	Time	Weight (g)	Technician
13084	2/6/2014	13:50	4.12779	mtuegel
13084	2/7/2014	13:15	4.12778	mtuegel
13084	2/10/2014	13:52	4.12773	mtuegel

Sample Weight Record

Media ID	Date	Time	Weight (g)	Technician
13084	3/28/2014	8:22	4.12815	mtuegel
13084	3/28/2014	15:39	4.12809	mtuegel

Sample ID:	29078-016	*Method:*	(7) U.S. EPA Method 202
Location:	All	*Sample Type:*	(7) B1/2 Inorganic Rinse
Run No:	FRB	*Recovery Date:*	3/18/2014
Field Tech:	JCM	*Initial pH:*	5.95

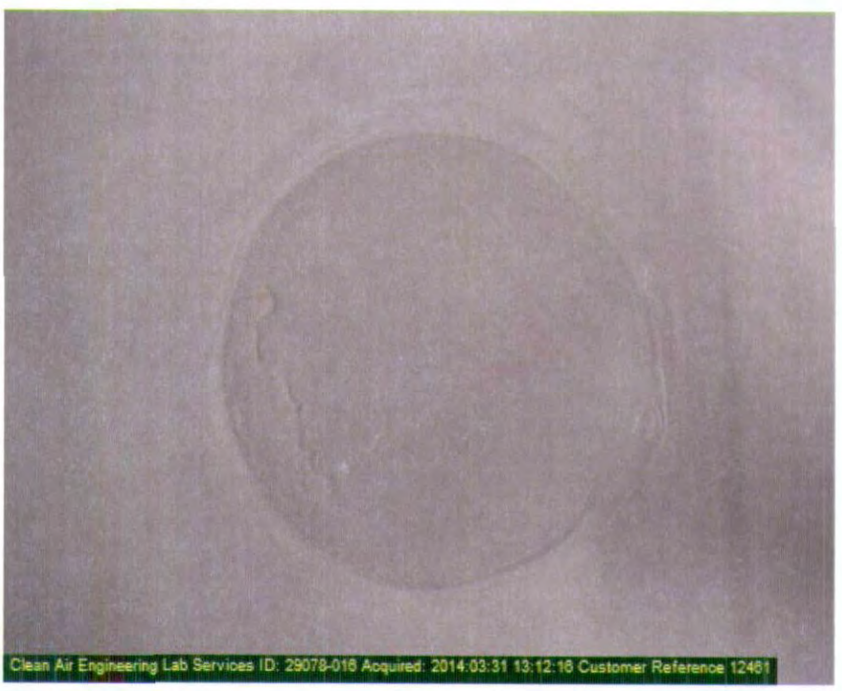
Media 1 ID: 13089

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13089	2/6/2014	15:01	4.02631	mtuegel
13089	2/7/2014	10:48	4.02633	mtuegel
13089	2/10/2014	14:49	4.02626	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13089	3/31/2014	8:59	4.02695	mtuegel
13089	3/31/2014	15:34	4.02696	mtuegel



Sample ID:	29078-017	*Method:*	(7) U.S. EPA Method 202
Location:	All	*Sample Type:*	(7) B1/2 Inorganic Rinse
Run No:	FTRB	*Recovery Date:*	3/20/2014
Field Tech:	JCM	*Initial pH:*	6.22

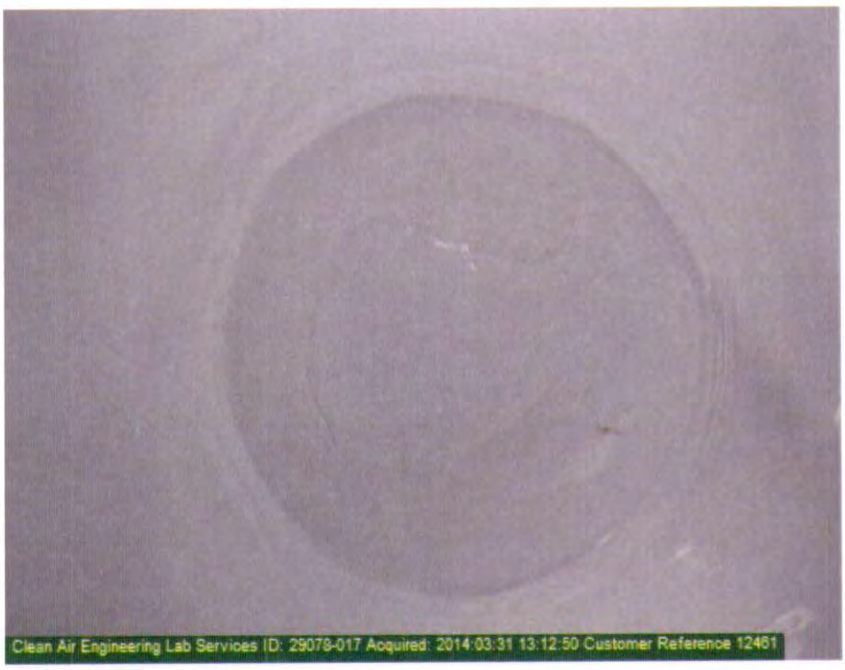
Media 1 ID: 13015

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13015	2/6/2014	14:54	4.00156	mtuegel
13015	2/7/2014	10:54	4.00163	mtuegel
13015	2/10/2014	14:39	4.00150	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13015	3/31/2014	9:04	4.00285	mtuegel
13015	3/31/2014	15:27	4.00283	mtuegel



Sample ID:	29078-018	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(7) B1/2 Inorganic Rinse
Run No:	1	*Recovery Date:*	3/18/2014
Field Tech:	JCM	*Initial pH:*	3.45

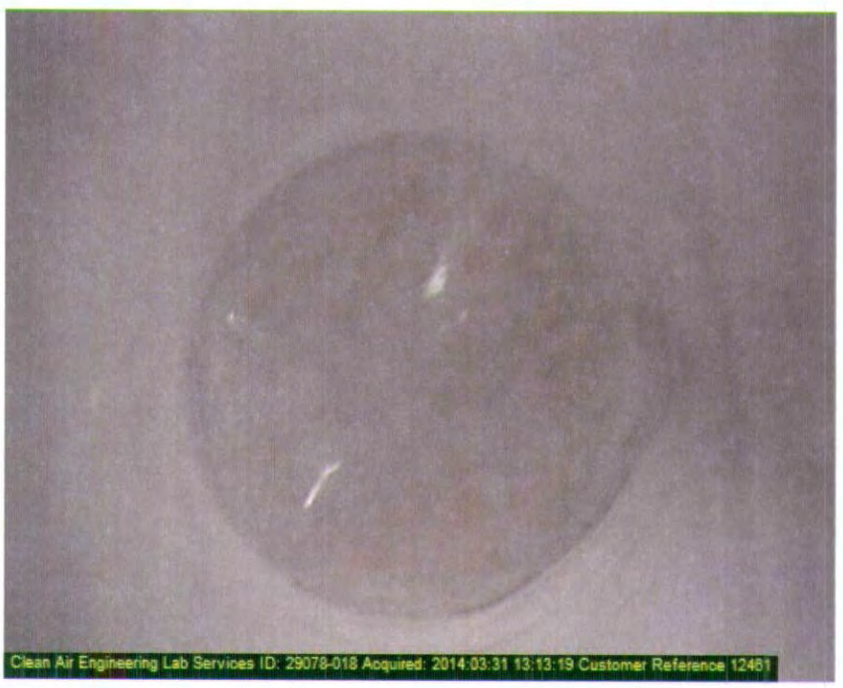
Media 1 ID: 13086

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13086	2/6/2014	14:43	4.14127	mtuegel
13086	2/7/2014	11:11	4.14131	mtuegel
13086	2/10/2014	14:38	4.14124	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13086	3/31/2014	8:59	4.15006	mtuegel
13086	3/31/2014	15:40	4.15006	mtuegel



Sample ID:	29078-019	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(7) B1/2 Inorganic Rinse
Run No:	2	*Recovery Date:*	3/19/2014
Field Tech:	JCM	*Initial pH:*	8.62

Media 1 ID: 13042

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13042	2/6/2014	14:43	4.18333	mtuegel
13042	2/7/2014	11:11	4.18340	mtuegel
13042	2/10/2014	14:38	4.18338	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13042	3/31/2014	9:04	4.23350	mtuegel
13042	3/31/2014	15:34	4.23349	mtuegel

Sample ID:	29078-020	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(7) B1/2 Inorganic Rinse
Run No:	3	*Recovery Date:*	3/19/2014
Field Tech:	SL	*Initial pH:*	3.44

Media 1 ID: 13047

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13047	2/6/2014	14:08	4.18257	mtuegel
13047	2/7/2014	11:16	4.18261	mtuegel
13047	2/10/2014	14:32	4.18256	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13047	3/31/2014	9:14	4.19083	mtuegel
13047	3/31/2014	15:27	4.19077	mtuegel

Sample ID:	29078-021	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(7) B1/2 Inorganic Rinse
Run No:	4	*Recovery Date:*	3/19/2014
Field Tech:	JCM	*Initial pH:*	3.53

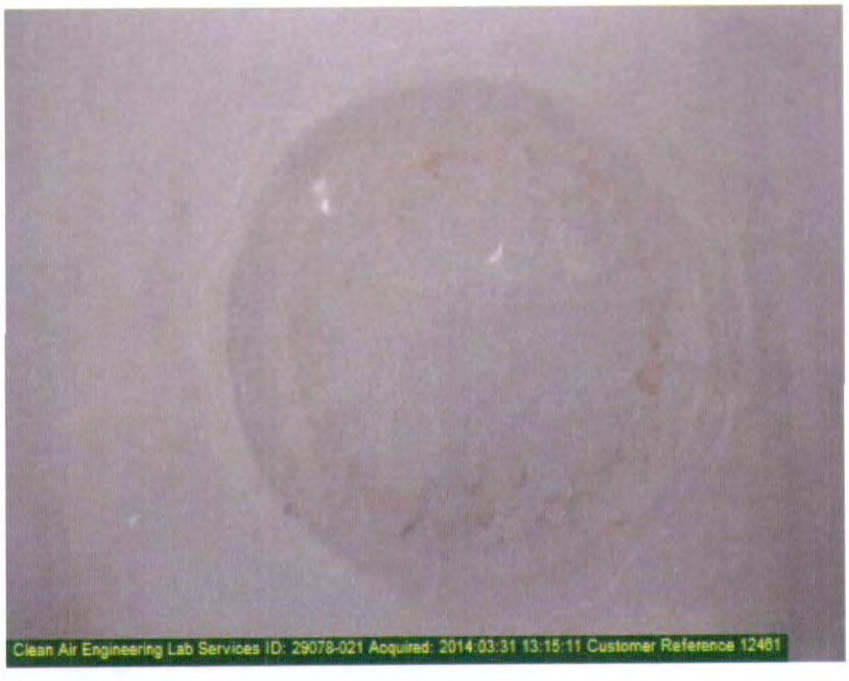
Media 1 ID: 13097

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13097	2/6/2014	14:43	3.99168	mtuegel
13097	2/7/2014	11:11	3.99174	mtuegel
13097	2/10/2014	14:32	3.99167	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13097	3/31/2014	8:52	3.99750	mtuegel
13097	3/31/2014	15:40	3.99750	mtuegel



Sample ID:	29078-022	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(7) B1/2 Inorganic Rinse
Run No:	5	*Recovery Date:*	3/19/2014
Field Tech:	JCM	*Initial pH:*	3.53

Media 1 ID: 13091

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13091	2/6/2014	14:00	4.14854	mtuegel
13091	2/7/2014	11:42	4.14857	mtuegel
13091	2/10/2014	13:58	4.14849	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13091	3/31/2014	8:59	4.16090	mtuegel
13091	3/31/2014	15:34	4.16086	mtuegel

Sample ID:	29078-022a	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(7) B1/2 Inorganic Rinse
Run No:	5	*Recovery Date:*	3/19/2014
Field Tech:			

Media 1 ID: 13091a

Media 1 Tared Weight Record

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13091a	4/1/2014	9:12	4.15622	mtuegel
13091a	4/1/2014	15:27	4.15606	mtuegel

Sample ID:	29078-023	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(7) B1/2 Inorganic Rinse
Run No:	6	*Recovery Date:*	3/20/2014
Field Tech:	JCM	*Initial pH:*	3.61

Media 1 ID: 13085

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13085	2/6/2014	13:49	4.06328	mtuegel
13085	2/7/2014	13:15	4.06320	mtuegel
13085	2/10/2014	13:57	4.06317	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13085	3/31/2014	9:04	4.06835	mtuegel
13085	3/31/2014	15:27	4.06832	mtuegel

Sample ID:	29078-024	*Method:*	(7) U.S. EPA Method 202
Location:	All	*Sample Type:*	(8) B1/2 Organic Rinse
Run No:	FRB	*Recovery Date:*	3/18/2014
Field Tech:	JCM		

Media 1 ID: 13081

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13081	2/6/2014	14:08	4.07221	mtuegel
13081	2/7/2014	11:16	4.07226	mtuegel
13081	2/10/2014	14:32	4.07221	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13081	3/31/2014	9:40	4.07224	mtuegel
13081	3/31/2014	15:46	4.07220	mtuegel

Sample ID:	29078-025	*Method:*	(7) U.S. EPA Method 202
Location:	All	*Sample Type:*	(8) B1/2 Organic Rinse
Run No:	FTRB	*Recovery Date:*	3/20/2014
Field Tech:	JCM		

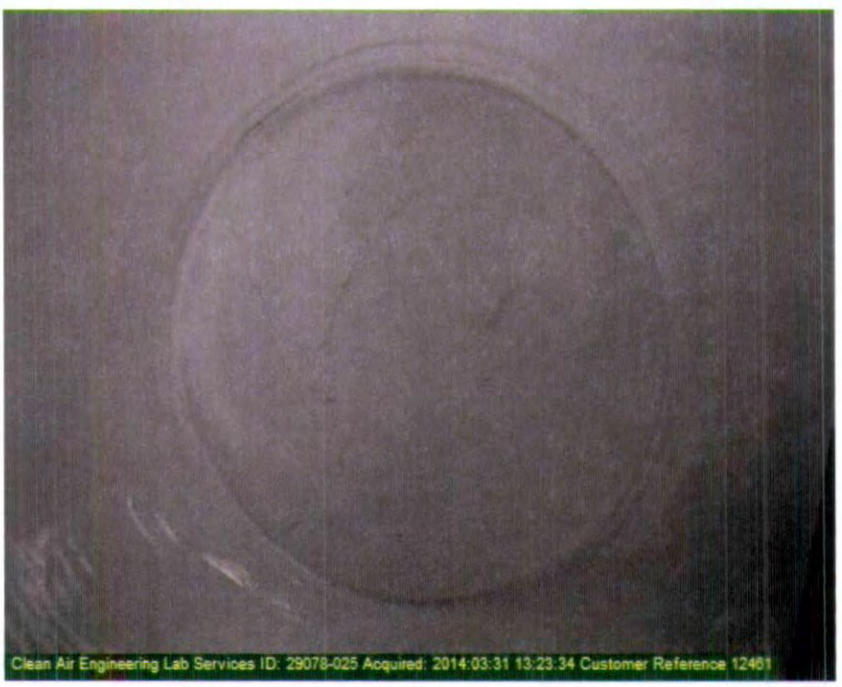
Media 1 ID: 13018

Media 1 Tared Weight Record

Media ID	Date	Time	Weight (g)	Technician
13018	2/6/2014	14:09	4.21004	mtuegel
13018	2/7/2014	11:16	4.21008	mtuegel
13018	2/10/2014	14:26	4.20999	mtuegel

Sample Weight Record

Media ID	Date	Time	Weight (g)	Technician
13018	3/31/2014	9:40	4.21137	mtuegel
13018	3/31/2014	15:54	4.21131	mtuegel



Sample ID:	29078-026	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(8) B1/2 Organic Rinse
Run No:	1	*Recovery Date:*	3/18/2014
Field Tech:	JCM		

Media 1 ID: 13036

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13036	2/6/2014	14:00	4.20443	mtuegel
13036	2/7/2014	11:42	4.20449	mtuegel
13036	2/10/2014	14:26	4.20444	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13036	3/31/2014	9:40	4.20660	mtuegel
13036	3/31/2014	15:46	4.20654	mtuegel

Sample ID:	29078-027	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(8) B1/2 Organic Rinse
Run No:	2	*Recovery Date:*	3/19/2014
Field Tech:	JCM		

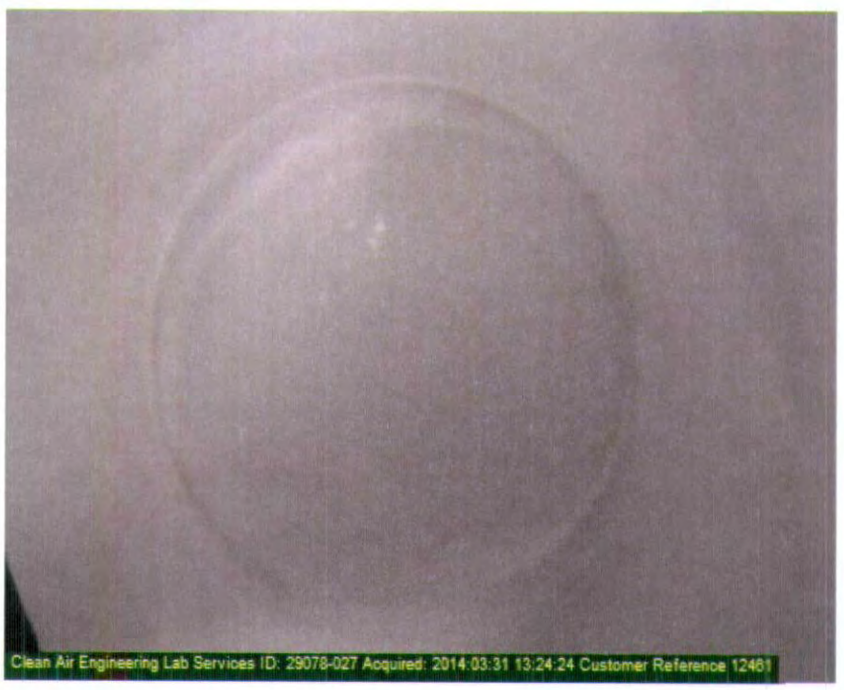
Media 1 ID: 13090

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13090	2/6/2014	13:55	4.04403	mtuegel
13090	2/7/2014	13:04	4.04400	mtuegel
13090	2/10/2014	14:13	4.04399	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13090	3/31/2014	9:27	4.04534	mtuegel
13090	3/31/2014	15:54	4.04528	mtuegel



Sample ID:	29078-028	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(8) B1/2 Organic Rinse
Run No:	3	*Recovery Date:*	3/19/2014
Field Tech:	SL		

Media 1 ID: 13087

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13087	2/6/2014	13:49	4.19190	mtuegel
13087	2/7/2014	13:15	4.19202	mtuegel
13087	2/10/2014	13:58	4.19182	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13087	3/31/2014	9:27	4.19298	mtuegel
13087	3/31/2014	16:03	4.19288	mtuegel

Sample ID:	29078-029	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(8) B1/2 Organic Rinse
Run No:	4	*Recovery Date:*	3/19/2014
Field Tech:	JCM		

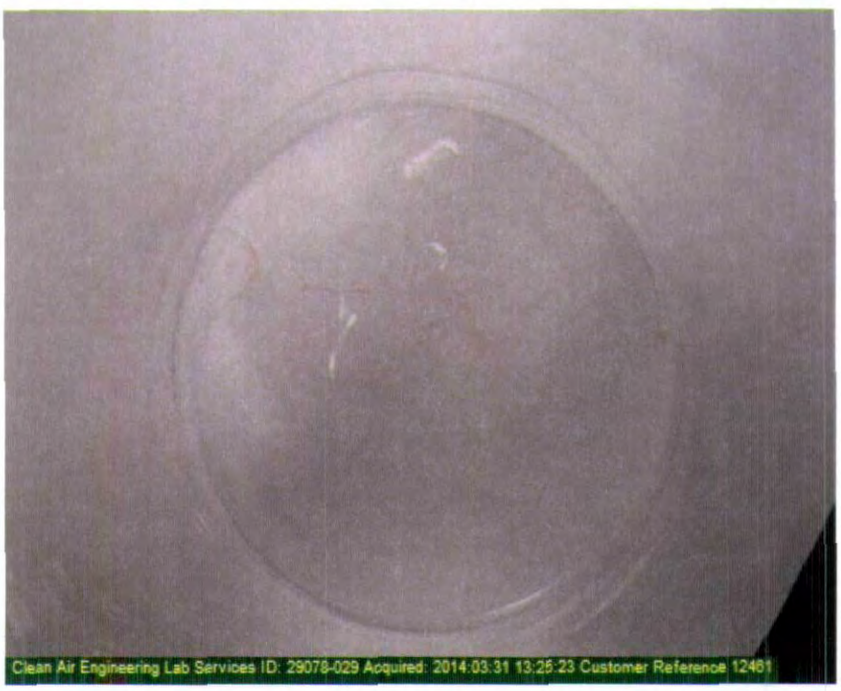
Media 1 ID: 13041

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13041	2/6/2014	13:55	4.20465	mtuegel
13041	2/7/2014	13:04	4.20473	mtuegel
13041	2/10/2014	14:14	4.20461	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13041	3/31/2014	9:27	4.20589	mtuegel
13041	3/31/2014	15:54	4.20587	mtuegel



Sample ID:	29078-030	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(8) B1/2 Organic Rinse
Run No:	5	*Recovery Date:*	3/19/2014
Field Tech:	JCM		

Media 1 ID: 13076

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13076	2/6/2014	14:00	4.13483	mtuegel
13076	2/7/2014	11:42	4.13490	mtuegel
13076	2/10/2014	14:26	4.13479	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13076	3/31/2014	9:20	4.13604	mtuegel
13076	3/31/2014	16:15	4.13598	mtuegel

Sample ID:	29078-031	*Method:*	(7) U.S. EPA Method 202
Location:	FCCU Regenerator Vent	*Sample Type:*	(8) B1/2 Organic Rinse
Run No:	6	*Recovery Date:*	3/20/2014
Field Tech:	JCM		

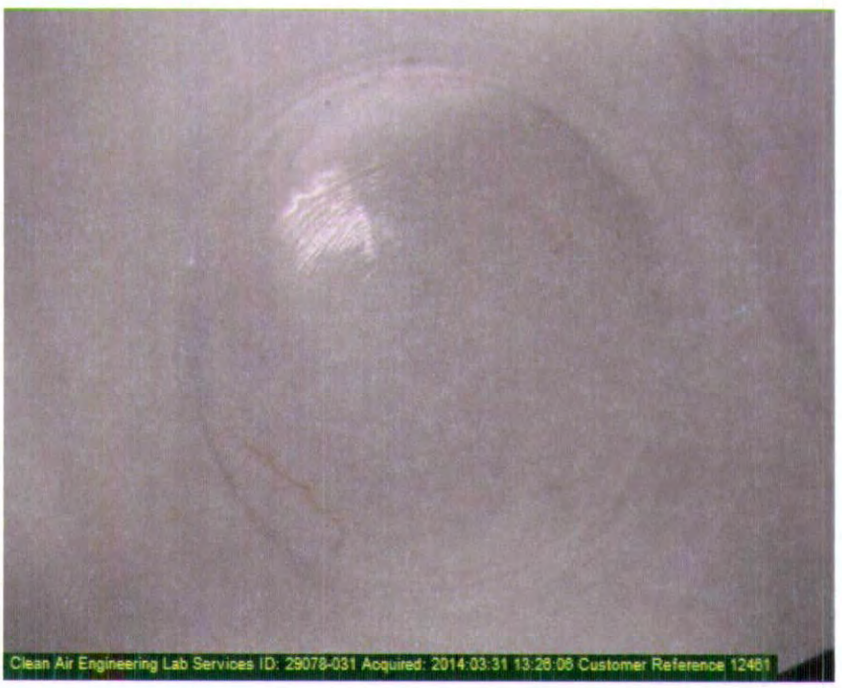
Media 1 ID: 13017

Media 1 Tared Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13017	2/6/2014	13:55	4.16875	mtuegel
13017	2/7/2014	13:04	4.16876	mtuegel
13017	2/10/2014	14:14	4.16869	mtuegel

Sample Weight Record

Media ID	*Date*	*Time*	*Weight (g)*	*Technician*
13017	3/31/2014	9:20	4.17019	mtuegel
13017	3/31/2014	16:03	4.17009	mtuegel



Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 8 (H2SO4)
Sulfate Laboratory Data Summary

Run No.		Blank	1	2	3
Date (2014)			Mar 20	Mar 20	Mar 20
Start Time (approx.)			09:31	11:55	13:26
Stop Time (approx.)			10:50	13:02	14:32

☐ DRAFT LAB DATA

MDL	Min. detectable limit (mg SO4--/liter)	1.3000

H2SO4 as Total Sulfate

B_i	Blank concentration (mg SO4--/liter)	0.0000

v_1	Fraction 1 sample volume (ml)	262.3000	374.5000	374.5000
m_a	H2SO4 collected before blank subtraction (mg)	18.0000	14.0000	15.1000
m_b	Allowable blank subtraction (mg)	0.0000	0.0000	0.0000
m_{nb}	H2SO4 collected after blank subtraction (mg)	18.0000	14.0000	15.1000
m_{MDL}	Minimum detectable H2SO4 (mg)	0.2840	0.4055	0.4055
m_n	Total H2SO4 used in emission calculations (mg)	18.0000	14.0000	15.1000

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA Method 8 (H2SO4)
Sulfate Laboratory Data Summary

Run No.		Blank	4	5	6
Date (2014)			Mar 21	Mar 21	Mar 21
Start Time (approx.)			08:23	10:06	11:42
Stop Time (approx.)			09:32	11:11	12:48

☐ DRAFT LAB DATA

MDL	Min. detectable limit (mg SO4--/liter)	1.3000

H2SO4 as Total Sulfate

B_i	Blank concentration (mg SO4--/liter)	0.0000

v_1	Fraction 1 sample volume (ml)	321.6	335.0	363.5
m_a	H2SO4 collected before blank subtraction (mg)	10.3000	11.3000	6.8800
m_b	Allowable blank subtraction (mg)	0.0000	0.0000	0.0000
m_{nb}	H2SO4 collected after blank subtraction (mg)	10.3000	11.3000	6.8800
m_{MDL}	Minimum detectable H2SO4 (mg)	0.3483	0.3628	0.3936
m_n	*Total H2SO4 used in emission calculations (mg)*	10.3000	11.3000	6.8800

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CleanAir

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LABORATORY ANALYSIS FOR H_2SO_4
Laboratory Services Report No: 64-29078_METHOD8_V0

Performed for:
CLEAN AIR HOUSTON SOURCE
31 Century Plaza
Suite 110
Houston, TX 77073

Pertaining to a Field Sampling Project Performed for :
MARATHON PETROLEUM CO. LP

Customer Reference No: 12461
Laboratory Services Project No: 29078
Revision 0: 04/07/2014

To the best of our knowledge, the laboratory report nor the results provided have in any way been reproduced or altered except in full without prior written approval of the lab. The laboratory results presented in this report are accurate, complete, error free, legible and representative of the samples per the analysis described here-in. The lab retains the unaltered final copy for comparison purposes upon request.

Submitted by,

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REVISION HISTORY

LABORATORY ANALYSIS FOR H2SO4
LABORATORY Services Report No: 64-29078_Method8_V0

FINAL REPORT REVISION HISTORY

Revision:	Date	Pages	Comments
0	04/07/2014	All	Final version of original document.

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CLEAN AIR HOUSTON SOURCE
MARATHON PETROLEUM CO. LP

Customer Reference No: 12461
Laboratory Services Project No: 29078

CERTIFICATE OF ANALYSIS

Sample Number	Sample Identification	Sample volume (mL)	Total Amount of Analyte (Reported as mg H_2SO_4)	MDL (Reported as mg H_2O_4)	RDL (Reported as mg H_2SO_4)
29078-039	FRB DI	199.8	<	0.68	2.0
29078-040	FRB 80% IPA	170.6	<	0.58	1.7
29078-041	FRB 80% IPA	168.9	<	0.57	1.7
29078-042	CU Regenerator Stack R1	262.3	18.0	0.89	2.6
29078-043	CU Regenerator Stack R2	374.5	14.0	1.3	3.7
29078-044	CU Regenerator Stack R3	374.5	15.1	1.3	3.7
29078-045	CU Regenerator Stack R4	321.6	10.3	1.1	3.2
29078-046	CU Regenerator Stack R5	335.0	11.3	1.1	3.3
29078-047	CU Regenerator Stack R6	363.5	6.88	1.2	3.6
29078-048	031214R Audit	1000	26.35	3.4	10

End of Section 1 – Certificate of Analysis

ANALYTICAL CASE NARRATIVE

INTRODUCTION

Clean Air Houston Source contracted Clean Air Laboratory Services to determine the following:

- H_2SO_4 Content

All analyses were performed on samples received by the laboratory at their facility in Palatine, IL. All analyses were performed in accordance with the applicable EPA Method requirements along with all NELAP quality requirements as outlined and described in Section 3 of this report.

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Key Project Participants

Samples were received at Clean Air Engineering Laboratory Services facility on March 25, 2014. Custody transfer occurred between the following personnel:

Table 2-2:
Pertinent Personnel

Technician	Affiliation	Function
S. Lehmann	Customer	COC Generation
A. Christianson	Customer	COC Relinquished
M. Tuegel	Laboratory Services	Sample Receipt
D. Rhoades	Laboratory Services	Sample Analysis

Accreditation

Clean Air Laboratory Services is accredited through the following state agencies.

Table 2-3:
Specific Accreditations and Expiration Dates

State	Certificate Number	Expiration Date
Texas	T104704431-13-4	8/31/2014
Louisiana	169249	6/30/2014
New Jersey	IL004	6/30/2014

Please visit the respective state websites to view our current accreditation status and a comprehensive list of our accredited services.

ANALYTICAL CASE NARRATIVE

DISCUSSION OF ANALYTICAL RESULTS

Table 2-4 shown below, presents the average amounts of H_2SO_4 found for each sample fraction. Also shown are the standard deviations (SD) and percent relative standard deviations (RSD). These data are not corrected for plant conditions or sampling volumes.

Table 2-4:
Statistical Description of the Titrimetric Results.

Sample Fraction	Location	Average Amount of Analyte (Reported as mg H_2SO_4)	Standard Deviation of Amount of Analyte (Reported as mg H_2SO_4)	Relative Standard Deviation of Amount of Analyte (%)
80% IPA	CU Regenerator Stack	13.0	3.7	28.7%

The samples were analyzed over a period of two days, from April 1, 2014 through April 2, 2014:

- All blank samples (29078-039 through 29078-041) were analyzed on 04/01/2014;
- Runs 1-3 (29078-042 through 29078-044) were analyzed on 04/01/2014; and
- Runs 4-6 and the Audit Sample (29078-045 through 29078-048) were analyzed on 04/02/2014.

A limited sample size (e.g. 262.3 mL for Run 1 – Sample No: 29078-042) limited the Laboratory's choice in titrimetric aliquot size. As per our standard procedures, a 10 mL aliquot of this sample was the first to be analyzed. This yielded in a titrimetric result of 1.4 mL. In order to improve both accuracy and precision, a larger aliquot was then obtained. A 25 mL aliquot then yielded an average titrimetric result of 3.5 mL.

This same basic technique was attempted with further samples. Limited amounts of Sample No: 29078-045 (Run 4) allowed for only two iterations of the final aliquot size used (100 mL) in the analyses. These two aliquots used still meet the method required analytical technique. Clean Air Laboratory Services generally prefers, however, to analyze three aliquots instead of two. Results for this sample are believed to be accurate and reliable for the two iterations used.

An Audit sample was analyzed along with the samples. Results reported to the audit sample provider were found to be within 1.3% of the originally assigned value. A full copy of the audit provider's report is provided in Appendix VI.

End of Section 2 – Analytical Case Narrative

METHODOLOGY

Clean Air Engineering followed procedures as detailed in U.S. EPA Method 6, U.S. EPA Method 8, and TCEQ Method 29. Table 3-2, below summarizes the methods and their respective sources.

Table 3-2:
List of Analytical Methodology

Title 40 CFR Part 60 Appendix A	
U.S. EPA Method 6	"Determination of Sulfur Dioxide Emissions From Stationary Sources"
U.S.EPA Method 8	"Determination of Sulfuric Acid Mist and Sulfur Dioxide Emissions From Stationary Sources"
Texas Air Control Board Laboratory Methods Manual	
TCEQ Method 29	"Determination of Sulfur Dioxide, Sulfur Trioxide and Sulfuric Acid Mist in Stack Gas Peroxide-Barium Titration Method"

These methods appear in detail in Title 40 of the Code of Federal Regulations (CFR) and are located on the internet at http://ecfr.gpoaccess.gov.

CleanAir followed specific quality assurance and quality control (QA/QC) procedures as outlined in the individual methods and as prescribed in CleanAir's internal Quality Manual. Results of recorded QA/QC activities performed by CleanAir are summarized in Appendix III.

METHODOLOGY

Analytical Procedures Common To All Methods

Sample Preparation

- Samples were manually shaken prior to aliquot removal for analysis.

Sample Volumes

- All sample volumes were determined by field personnel.

Detection Limits

- The Method Detection Limit (MDL) was determined in accordance with procedures in 40 CFR 136, Appendix B. Documentation showing the determination of detection limits is included with this report. The Method Reporting Limit (MRL) was determined by using the smallest incremental increase from the blank that can be measured. Values between these limits were quantified, but should be used with discretion as they were below the MRL. Values that were below the MDL were indicated by a "<" where appropriate.

METHODOLOGY

Quality Control Procedures

Clean Air adheres to QA/QC procedures that both meet and exceed EPA requirements.

- Sample analysis was done in triplicate
- Each triplicate measurement must be found to have an average deviation of less than 0.05 mL.
- A matrix spike sample was performed every 10 samples. The recovery must be between 90% and 110%.
- A Quality Control sample was performed every 10 samples. The recovery must be within 5% of the expected value.

Standard and Reagent Traceability

- The calibration standard has been purchased to a concentration of 0.02 ± 0.00002 N. This and all reagents have been designated an original lot number. This number can be used to trace back to the original bottle used in the calibration of the titrant. This number is included on the data sheet within the report.

Project Archival

- A copy of this report and all associated supporting records will be archived and stored for at least 20 years.
- All samples are archived for a period of one year from the date of receipt in our facility.
- The archival facility is a controlled access storage facility that does not incorporate any environmental controls.

Reporting Abbreviations

1 FRB: Field Reagent Blank
2 FTRB: Field Train Reagent Blank
3 TP: Train Proof
4 F1/2: Front Half
5 B1/2: Back Half

End of Section 3 – Methodology

APPENDIX

SAMPLE CALCULATIONS I
RAW DATA II
QUALITY ASSURANCE RECORDS III
CHAIN-OF-CUSTODY DOCUMENTATION IV
DETECTION LIMIT DETERMINATION DATA V
AUDIT SAMPLE RESULTS VI

SAMPLE CALCULATIONS

i

Calculations

Titrimetric Analysis

Sample Number: 29078-042

1. Determination of Average Titrant Volume Used.

$$V_{tavg} = \frac{\sum_{i=1}^{n} (V_{t\_i})}{n}$$

Variable	Description	Example
V_{tavg}	Average Volume of Titrant (mL)	3.50
n	Number of Iterations	3
V_{t1}	Volume of Titrant used for trial 1 (mL)	3.50
V_{t2}	Volume of Titrant used for trial 2 (mL)	3.50
V_{t3}	Volume of Titrant used for trial 3 (mL)	3.50

2. Determination of Average Deviation

$$\sigma_{avg} = \frac{|V_{T1} - V_{avg\_t}| + |V_{T2} - V_{avg\_t}| + |V_{T3} - V_{avg\_t}|}{n}$$

Variable	Description	Example
V_{T1}	Volume of Titrant Trial 1 (mL)	3.50
V_{T2}	Volume of Titrant Trial 2 (mL)	3.50
V_{T3}	Volume of Titrant Trial 3 (mL)	3.50
V_{avg_t}	Volume of Titrant used per Trial (mL)	3.50
n	Number of Trials	3
σ_{avg}	Average Deviation	0.00

3. Determination of the Standardization of the Titrant

$$N_T = \frac{V_S \times N_S}{V_T}$$

Variable	Description	Example
N_T	Normality of titrant used	0.01016
V_S	Volume aliquot of Standard used (mL)	10.00
N_S	Normality of standard used (Certified at 0.02N)	0.020
V_T	Volume aliquot of titrant used (mL)	19.73

4. Determination of the Total Amount of Analyte in the Sample.

$$M_A = \frac{(V_T - V_B)(N_T)(MW)(V_{Soln})}{2(V_A)}$$

Variable	Description	Example
M_A	Mass of analyte (mg)	18.03
V_T	Average Volume of Titrant used (mL)	3.5
V_B	Averge Volume of Titrant used for Lab Blank (mL)	0.05
N_T	Normality of titrant used (N)	0.0102
MW	Molecular Weight of Analyte (mg/mg-mole)	98.06
V_{Soln}	Total sample volume (mL)	262.3
V_A	Aliquot of sample used for titration (mL)	25
2	Constant (meq/m-mole)	2

5. Determination of QC Percent Recovery

$$R_F = \frac{C_{(Exp.)}}{C_{(Act)}}(100)$$

Variable	Description	Example
$C_{(Exp)}$	Experimental Concentration (mg/L)	292.74
$C_{(Act)}$	Actual Concentration (mg/L)	304.30
R_F	Percent Recovery (%)	96.2%
100	Conversion Constant	100

6. Theoretical Amount of Analyte In Matrix Spike (from the sample)
From originally measured amount of analyte in sample.

$$M_{AMS} = \frac{(M_A)(V_{AMS})}{V_{Soln}}$$

Variable	Description	Example
M_A	Mass of analyte (mg)	18.03
V_{AMS}	Aliquot Volume Used for Matrix Spike Titration (mL)	20
V_{Soln}	Total sample volume (mL)	262.3
M_{AMS}	Mass of analyte used in Matrix Spike (mg)	1.37

7. Theoretical Amount of Spike In Matrix Spike

$$M_{Std} = \frac{(MW)(V_{aStd})(N_S)}{2}$$

Variable	Description	Example
V_{aStd}	Aliquot Volume of Std Used for Matrix Spike Titration (mL)	2
N_S	Normality of standard used (Certified at 0.02N)	0.020
M_{Std}	Mass of Standard used in Matrix Spike (mg)	1.961
MW	Constant - Molecular weight of analyte (mg/mg-mole)	98.06
2	Constant - meq/mg-mole	2.00

8. Theoretical Total Amount of Analyte In Matrix Spike

$$M_{MS} = M_{AMS} + M_{Std}$$

Variable	Description	Example
M_{AMS}	Mass of analyte used in Matrix Spike (mg)	1.37
M_{Std}	Mass of Standard used in Matrix Spike (mg)	1.961
M_{MS}	Mass of Analyte in Matrix Spike (mg)	3.336

9. Determination of the Total Amount of Analyte in the Sample.

$$M_A = \frac{(V_T - V_B)(N_T)(MW)(V_{Soln})}{2(V_A)}$$

Variable	Description	Example
M_A	Mass of analyte (mg)	3.44
V_T	Average Volume of Titrant used (mL)	6.92
V_B	Averge Volume of Titrant used for Lab Blank (mL)	0.05
N_T	Normality of titrant used (N)	0.0102
MW	Molecular Weight of Analyte (mg/mg-mole)	98.06
V_{Soln}	Total sample volume (mL)	22
V_A	Aliquot of sample used for titration (mL)	22
2	Constant (meq/m-mole)	2

10. Determination of Spike Percent Recovery

$$R_{f\_s} = 100\frac{(M_A - M_{AMS})}{M_{Std}}$$

Variable	Description	Example
M_A	Mass of analyte (mg)	3.44
M_{AMS}	Mass of analyte used in Matrix Spike (mg)	1.37
M_{Std}	Mass of Standard used in Matrix Spike (mg)	1.961
100	Constant Conversion to percent	100
R_{f_s}	Percent Recovery (%)	105.1%

11. Determination of Average Titrant Used for Blank for MDL Study

$$C_{bavg} = \frac{\sum_{i=1}^{n} V_{b\_i}}{n}$$

Variable	Description	Example
V_{b_i}	Volume of Titrant Used for Blank (mL)	0.05
n	Number of Aliquot Blanks	10
C_{bavg}	Average Titrant Used for Blank (mL)	0.05

12. Determination of the Blank Correction

$$Blank_C = (V_T - C_{bavg})$$

Variable	Description	Example
V_T	Volume of Titrant Used (mL)	0.65
C_{bavg}	Average Titrant Used for Blank (mL)	0.05
$Blank_C$	Blank Correction (mL)	0.60

13. Determination of MDL Spike Concentration

$$C_S = \frac{(M_{AMDL})(1000)}{V_S}$$

Variable	Description	Example
V_S	Volume of Spike (mL)	25
C_S	Spike Concentration (mg/L)	30.43
1000	Conversion Constant (mL to L)	1000
M_{AMDL}	Titrimetrically Determined Mass of Analyte in MDL Spike	0.75

14. Determination of the Average MDL Spike Recovery

$$R_A = (\frac{Blank_C}{C_{MDL}})(100)$$

Variable	Description	Example
$Blank_C$	Average Blank Correction (mL)	30.66452542
C_S	Spike Concentration (mg/L)	30.43
R_A	Average Recovery (%)	100.8%
100	Constant from decimal to percent	100

15. Determination of the Standard Deviation of MDL Spike Results

$$\sigma_{f\_i} = \sqrt{\frac{\sum_{i=1}^{n} (C_{S\_i} - C_{avgs})^2}{(n-1)}}$$

Variable	Description	Example
C_{S_i}	Concentration of Individual Spikes (mg/L)	29.92
C_{avgs}	Average Concentration of Spikes (mg/L)	30.66
n	Number of Spike Aliquots	10
σ_{f_i}	Standard Deviation of Spike Results	1.20

16. Determination of the RMS Deviation of MDL Spike Results

$$RMS_{f\_i} = \left(\frac{\sigma_{f\_i}}{Blank_{avgc}}\right)(100)$$

Variable	Description	Example
σ_{f_i}	Standard Deviation	1.20
$Blank_{avgc}$	Average Blank Corrected Concentration (mg/L)	30.66
100	Conversion Constant	100
RMS_{f_i}	RMS deviation of spike results (%)	3.9%

17. Determination of the Method Detection Limit

$$MDL = (\sigma_{f\_i})(t_{(n-1,0.99)})$$

Variable	Description	Example
σ_{f_i}	Standard Deviation	1.20
$t_{(n-1,0.99)}$	Student's t-value appropriate for a 99% confidence (n-1 degrees of freedom)	2.821
MDL	Method Detection Limit	3.40

18. Determination of the Reporting Detection Limit

$$RDL = \frac{(.2)(N_T)(MW)(V_S)(1000)}{(V_A)(V_S)(2)}$$

Variable	Description	Example
0.2	Volume of titrant used for RDL Purposes	0.2
N_T	Normality of Titrant (N)	0.01017
MW	Molecular Weight of Analyte (mg/mg-mole)	98.06
V_S	Volume of Spike Used (mL)	25
V_A	Volume of Aliquot Used (mL)	10
2	Constant (meq/m-mole)	2
1000	Conversion constant	1000
RDL	Reporting Detection Limit	9.97

RAW DATA

ii

CleanAir

SO_2 /SO_3 / H_2SO_4
Titrimetric Analysis

Client:	Clean Air Houston Source	Laboratory Project No:	29078
Plant/Facility:	Marathon Petroleum Co.	Analyst:	D. Rhoades
Customer Reference Number:	12461	Date:	04/01/14
2-Propanol Lot #	0303/402-64-00000-02	Titrant Lot #	10301204-66-13172-01 N_i
H2SO4 Lot #:	020911-10705B-64-05	Thorin Lot No:	02131402-64-00000-01

Sample Number	Identification	V_{soln}	V_a	V_{t1}	V_{t2}	V_{t3}	V_{tavg}	
CAL-001	LAB 0.02N H2SO4	N/A	10	19.8	19.7	19.7		Pipet Used 4827
LRB-001	LAB DI Water	N/A	10	0.05	0.05	0.05		
LRB-002	LAB 80% IPA	N/A	10	0.05	0.05	0.05		
29078-039	DI Blank	99.8	10	0.05	0.05	0.05		
29078-040	80% IPA Blank	170.6	10	0.05	0.05	0.05		
29078-041	80% IPA Blank	168.9	10	0.05	0.05	0.05		
29078-042	FCCU Regen 80% IPA R1	262.3	10	1.4				
29078-042	" " " "	"	25	3.5	3.5	3.5		1236
29078-043	" " " R2	374.5	25	2.1				
29078-043	" " " "	"	50	3.8	3.8	3.8		7442
29078-044	" " " R3	323.7	50	4.1	4.05	4.1		
29078-041	80% IPA Blank	168.9	25	0.05	0.05	0.05		1236
29078-041	" " "	"		—				
LRB-003	Lab DI Water	N/A	50	0.05	0.05	0.05		7442

QA Sample: QC Standard							Concentration	
Sample Number	Identification	V_{soln}	V_a	V_{t1}	V_{t2}	V_{t3}	V_{tavg}	% Recovery
LQC-001								
LQC-002								

QA Sample: Matrix Spikes							
Sample Number	Identification		V_{t1}	V_{t2}	V_{t3}	V_{tavg}	% Recovery
LMS-001	Matrix Spike						
LMS-002	Matrix Spike						
LMS-003	Matrix Spike						

† 2 mL of standard + 8 mL of sample
• 1 mL of standard + 4 mL of sample

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Date 6/4/2014
Time 3:59 PM

CleanAir

SO_2 / SO_3 / H_2SO_4
Titrimetric Analysis

Client:	Clean Air Houston Source	Laboratory Project No:	29078
Plant/Facility:	Marathon Petroleum Co.	Analyst:	DKhoades
Customer Reference Number:	12461	Date:	04/02/14
2-Propanol Lot #		Titrant Lot #	N_t:
H2SO4 Lot #			

Sample Number	Identification	V_{soln}	V_a	V_{t1}	V_{t2}	V_{t3}	V_{tavg}
CAL-001 2	(QR) LAB 0.02N H2SO4	N/A	10	19.65	19.65	19.7	
LRB-001 4	LAB DI Water	N/A	10	0.05	0.05	0.05	
LRB-002	LAB 80% IPA	N/A					
29078-045	FCCU Region 80% IPA R4	321.6	50	3.25			
29078-045	" " " "	321.6	100	6.45	6.45		
29078-046	" " " R5	335.0	100	6.80	6.80	6.80	
29078-047	" " " R6	363.5	100	3.85	3.80	3.80	
LRB-005	LAB DI Water	N/A	100	0.05	0.05	0.05	
29078-043	Audit 031314R	1000	10	0.6			
29078-048	" 031314R	1000	100	5.30	5.35	5.35	
	Pipet 2977						
	Flask 4927						
29078-042	LMS QC R1		50/2	6.90	6.95	6.90	
	2 mL of 0.02N Std						
	20 mL of 29078-042						

Pipet Used
4827
7442
6898
4827
6898
9402
9812

QA Sample QC Standard — Concentration: 304.3 mg/L

Sample Number	Identification	V_{soln}	V_a	V_{t1}	V_{t2}	V_{t3}	V_{tavg}	% Recovery
LQC-001	QC Sample		10	5.90	5.90	5.90		483
LQC-002								

QA Sample Matrix Spikes

Sample Number	Identification		V_{t1}	V_{t2}	V_{t3}	V_{tavg}	% Recovery
LMS-001	Matrix Spike						
LMS-002	Matrix Spike						
LMS-003	Matrix Spike						

† 2 mL of standard + 8 mL of sample
• 1 mL of standard + 4 mL of sample

QC Std Lot No: 03071402-01-00000-04
H_2O_2 Lot No: 102412.122628-66-06

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CleanAir

Page 3 of 3

SO_2 /SO_3 / H_2SO_4

Titrimetric Analysis

Client:	Clean Air Houston Source	Laboratory Project No:	29078
Plant/Facility:	Marathon Petroleum Co.	Analyst:	D. Rhoades
Customer Reference Number:	12461	Date:	04/03/14
2-Propanol Lot #		Titrant Lot #	N_t:
H2SO4 Lot #:			

MDL Study

Sample Number	Identification	V_{soln}	V_a	V_{t1}	V_{t2}	V_{t3}	V_{tavg}	Pipet Used
CAL-001	LAB 0.02N H2SO4	N/A	10	19.65	19.65	19.7		4827
LRB-001	LAB DI Water	N/A						
LRB-002	LAB 80% IPA	N/A						
MDL Lab Blanks			10	0.05	0.05	0.05		4827
"	" "		10	0.05	0.05	0.05		
"	" "		10	0.05	0.05	0.05		
"	" "		10	0.05				
MDL Study Spikes		250	10	0.65	0.70	0.65		
	Pipet - 1236 25 mL		10	0.65	0.65	0.65		
	Flask - 1195 250 mL		10	0.70	0.65	0.65		
	Lot No: 04031403-64-1240-01		10	0.70				

QA Sample: QC Standard

Sample Number	Identification	V_{soln}	V_a	V_{t1}	V_{t2}	V_{t3}	Concentration: V_{tavg}	% Recovery
LQC-001								
LQC-002								

QA Sample: Matrix Spikes

Sample Number	Identification		V_{t1}	V_{t2}	V_{t3}	V_{tavg}	% Recovery
LMS-001	Matrix Spike						
LMS-002	Matrix Spike						
LMS-003	Matrix Spike						

† 2 mL of standard + 8 mL of sample
• 1 mL of standard + 4 mL of sample

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QUALITY ASSURANCE RECORDS

SO_2 /SO_3 / H_2SO_4

Titrimetric Analysis

Client:	Clean Air Houston Source Testing	Laboratory Project No:			29078
Plant/Facility:	Marathon Petroleum Company	Analyst:			Doug Rhoades
Customer Reference Number:	12461	Date:			04/01/14
2-Propanol Lot #	03031402-64-00000-02	Titrant Lot #	10301204-66-12172-01	N_t:	0.01016
H2SO4 Lot #:	020911-107058-64-05				

Sample Number	Identification	V_{soln}	V_a	V_{t1}	V_{t2}	V_{t3}	V_{tavg}
CAL-001	LAB 0.02N H2SO4	N/A	10.00	19.80	19.70	19.70	19.73
LRB-001	LAB DI Water	N/A	10.00	0.05	0.05	0.05	0.05
LRB-002	LAB 80% IPA	N/A	10.00	0.05	0.05	0.05	0.05
29078-39	FRB DI	199.8	10.00	0.05	0.05	0.05	0.05
29078-40	FRB 80% IPA	170.6	10.00	0.05	0.05	0.05	0.05
29078-41	FRB 80% IPA	168.9	10.00	0.05	0.05	0.05	0.05
29078-42	FCCU Regen 80% IPA R1	262.3	10.00	1.40			1.40
29078-42	FCCU Regen 80% IPA R1	262.3	25.00	3.50	3.50	3.50	3.50
29078-43	FCCU Regen 80% IPA R2	374.5	25.00	2.10			2.10
29078-43	FCCU Regen 80% IPA R2	374.5	50.00	3.80	3.80	3.80	3.80
29078-44	FCCU Regen 80% IPA R3	374.5	50.00	4.10	4.05	4.10	4.08
29078-41	FRB 80% IPA	168.9	25.00	0.05	0.05	0.05	0.05
LRB-003	LAB DI Water	N/A	50.00	0.05	0.05	0.05	0.05

CleanAir

SO_2 /SO_3 / H_2SO_4

Titrimetric Analysis

Client:	Clean Air Houston Source Testing	Laboratory Project No:			29078
Plant/Facility:	Marathon Petroleum Company	Analyst:			Doug Rhoades
Customer Reference Number:	12461	Date:			04/02/14
2-Propanol Lot #	03031402-64-00000-02	Titrant Lot #	10301204-66-12172-01	N_t:	0.0102041
H2SO4 Lot #:	020911-107058-64-05				

Sample Number	Identification	V_{soln}	V_a	V_{t1}	V_{t2}	V_{t3}	V_{tavg}
CAL-002	LAB 0.02N H2SO4	N/A	10.00	19.65	19.65	19.70	19.65
LRB-004	LAB DI Water	N/A	10.00	0.05	0.05	0.05	0.05
LRB-005	LAB DI Water	N/A	100.00	0.05	0.05	0.05	0.05
29078-45	FCCU Regen 80% IPA R4	321.6	50.00	3.25			3.25
29078-45	FCCU Regen 80% IPA R4	321.6	100.00	6.45	6.45		6.45
29078-46	FCCU Regen 80% IPA R5	335.0	100.00	6.80	6.80	6.80	6.80
29078-47	FCCU Regen 80% IPA R6	363.5	100.00	3.85	3.85	3.80	3.83
29078-48	031214R Audit	1000.0	10.00	0.60			0.60
29078-48	031214R Audit	1000.0	100.00	5.30	5.35	5.35	5.32
QA Sample: QC Standard							Concentration:
Sample Number	Identification	V_{soln}	V_a	V_{t1}	V_{t2}	V_{t3}	V_{tavg}
LQC-001	304.30mg/L Sulfate QC Standard	500.0	10.00	5.90	5.90	5.90	5.90
QA Sample: Matrix Spikes							
Sample Number	Identification		V_{t1}	V_{t2}	V_{t3}	V_{tavg}	**% Recovery**
LMS-001	80% IPA Matrix Spike †		6.90	6.95	6.90	6.92	105.1%

† 2 mL of 0.02N H2SO4 standard + 20 mL of sample 29078-042

CleanAir

SO_2 /SO_3 / H_2SO_4

Titrimetric Analysis

Client:	Clean Air Houston Source Testing	Laboratory Project No:	29078
Plant/Facility:	Marathon Petroleum Co.	Analyst:	Doug Rhoades
Customer Reference Number:	12461	Date:	04/03/14

Sample Number	Identification	V_{soln}	V_a	V_{t1}	V_{t2}	V_{t3}	V_{tavg}
CAL-001	LAB 0.02N H2SO4	N/A	10.00	19.65	19.65	19.70	19.67
LRB-001	LAB DI Water	N/A	10.00	0.05	0.05	0.05	0.05

CHAIN-OF-CUSTODY DOCUMENTATION

CLIENT Marathon
PLANT Garyville
PROJECT MANAGER S. Lehmann

PROJECT 12461
DEPT. 66

66-12461-6

CleanAir ENGINEERING
500 West Wood Street
Palatine, IL 60067
800-627-0033 (phone)
847-991-3385 (fax)

ANALYTICAL METHOD	CONTAINER NUMBER	SAMPLE FRACTION
USEPA M-8	1	H_2SO_4 CATCH AND RINSE, PLUS FILTER 1000 mL HDPE

29078

LAB ID NUMBER	DATE (2014)	TEST LOCATION	RUN NUMBER	SAMPLE MATRIX	NUMBER OF CONTAINERS	CONTAINER SEALED? LIQUID LEVEL MARKED?	ANALYSIS REQUESTED				ADDITIONAL INFORMATION
								Sulfate		Archive	
-042	3/20 ✓	CU Regenerator Stack	1	H_2SO_4 Catch and Rinse, Plus Filter, 1000 mL HDPE, 262g	1	x	X			X	80% IPA rinse
-043	3/20 ✓	CU Regenerator Stack	2	H_2SO_4 Catch and Rinse, Plus Filter, 1000 mL HDPE	1	x	X				
-044	3/21 ✓	CU Regenerator Stack	3	v f	1	x	X				
-045	3/21 ✓	CU Regenerator Stack	4	H_2SO_4 Catch and Rinse, Plus Filter, 1000 mL HDPE, 322g	1	x	X				
-046	3/21 ✓	CU Regenerator Stack	5	H_2SO_4 Catch and Rinse, Plus Filter, 1000 mL HDPE335g	1	x	X				
-047	3/21 ✓	CU Regenerator Stack	6	H_2SO_4 Catch and Rinse, Plus Filter, 1000 mL HDPE, 363.5g	1	x	X				
-040/-041	✓ 3/20 3/21	Reagent Blank	All	80% IPA and Filter (~250 mL), 1000 mL HDPE 200g	2	x	X				
-039	✓ 3/21 3/20	Reagent Blank	All	DI Water (200 mL), 1000 mL HDPE, 199.8 g	1	x	X				
-048		PT-SAMPLE	All	Sulfuric Acid & Bromide Impinger Sol'n	1		X				No COC Recv'd

FORWARDING LAB
CleanAir Analytical Services
500 West Wood Street
Palatine, IL 60067
800-627-0033 (phone)
Doug Rhoades

Relinquished By: (signature)	Date / Time	Relinquished By: (signature)	Date / Time	Relinquished By: (signature)	Date / Time	This form completed by:
A. Christiansen						S. Lehmann
Received By: (signature)	**Date / Time**	**Received By: (signature)**	**Date / Time**	**Relinquished By: (signature)**	**Date / Time**	**Signature / Date**
	3/25/14					

DETECTION LIMIT DETERMINATION DATA

V

Determination of Method Detection Limit

Customer:	Clean Air Houston Source Testing	Lab Project No:	29078	Analyst:	Doug Rhoades
Plant:	Marathon Petroleum Co.	Customer Ref. No:	12461		

MDL Reference 40 CFR 136, Appendix B

Matrix 80% IPA
MDL Standard Lot No:
Blank Concentration 0.05 ml
Spike Volume 25.0 ml
Spike Amount Added 0.76 mg SO4
Aliquot Amount 10.0 ml
Titrant Normality 0.01017 N
Spike Concentration 30.43 mg/L SO4

Non-Iterative Study

No. of Replicates	$t_{(n-1,0.99)}$
7	3.143
8	2.998
9	2.896
10	2.821
11	2.764
16	2.602
21	2.528

Blank Aliquots	Blank Result (mL) Titrant Used
1	0.05
2	0.05
3	0.05
4	0.05
5	0.05
6	0.05
7	0.05
8	0.05
9	0.05
10	0.05

Average Blank Conc: 0.05

Spike Aliquots	Date of Spike Analysis	Spike Result Titrant Used (mL)	Blank Correction Titrant Used (mL)	Spike Result (mg SO4) Net (r_{a_i})	Spike Result (mg/L SO4) Net (r_{a_i})
1	4/3/2014	0.65	0.60	0.75	29.92
2	4/3/2014	0.70	0.65	0.81	32.41
3	4/3/2014	0.65	0.60	0.75	29.92
4	4/3/2014	0.65	0.60	0.75	29.92
5	4/3/2014	0.65	0.60	0.75	29.92
6	4/3/2014	0.65	0.60	0.75	29.92
7	4/3/2014	0.70	0.65	0.81	32.41
8	4/3/2014	0.65	0.60	0.75	29.92
9	4/3/2014	0.65	0.60	0.75	29.92
10	4/3/2014	0.70	0.65	0.81	32.41

Average Blank Corrected (m_{a_i}): 30.66
Recovery (R_a): 100.8%
Standard Deviation (S_a): 1.20
RMS Deviation: 3.9%
$t_{(n-1,0.99)}$: 2.821
MDL_a: 3.40 mg/L SO4
RDL 9.97 mg/L SO4

Is the spike level higher than the MDL? Yes
Is the spike level less than ten times the MDL? Yes
Is the Avg Recovery between 90% < R_a < 110% ? Yes

File: SPS-64-29078_Marathon_M8_040314_V0.xlsx
Date: 4/7/2014
Time: 9:16 AM

AUDIT SAMPLE RESULTS

ERA
A Waters Company

Doug Rhoades
Clean Air Enginering
500 W Wood St
Palatine, IL 60067

031214R Final Report

Air and Emissions Proficiency Testing

ERA
A Waters Company

April 3, 2014

Doug Rhoades
Clean Air Enginering
500 W Wood St
Palatine, IL 60067

Enclosed is your final report for ERA's Stationary Source Audit Sample (SSAS) Program. Your final report includes an evaluation of all results submitted by your laboratory to ERA.

Data Evaluation Protocols: All analytes in ERA's SSAS Program have been evaluated comparing the reported result to the acceptance limits generated using the criteria contained in the TNI SSAS Table.

For any "Not Acceptable" results, please contact your state regulator for any corrective action requirements.

Thank you for your participation in ERA's SSAS Program. If you have any questions, please contact our Proficiency Testing Department at 1-800-372-0122.

Sincerely,

Kristina Sanchez
Quality Officer

cc: Project File Number 031214R

ERA
A Waters Company

Recipient Type	Report Recipient	Contact
Agency	LA DEQ (SSAS) 602 N 5th Street PO Box 4313 Baton Rouge, LA 70821 USA	Kevin Braxton kevin.braxton@la.gov Phone: 225-219-3592
Facility	Marathon Petroleum 4663 W. Airline Highway Garyville, LA 70051 USA	Elizabeth Olavesen eyolavesen@marathonpetroleum.com Phone: 985-535-7565
Lab	Clean Air Enginering 500 W Wood St Palatine, IL 60067 USA	Doug Rhoades drhoades@cleanair.com Phone: 847-991-6200
Tester	Clean Air Enginering 500 W Wood St Palatine, IL 60067 USA	Scott Lehmann slehmann@cleanair.com Phone: 847-654-4600

Report Recipient	Contact/Phone Number	Reporting Type	Evaluation Type
LA DEQ (SSAS)	Kevin Braxton / 225-219-3592	All Analytes	2009 TNI

031214R Laboratory Exception Report

A Waters Company

Doug Rhoades
Clean Air Enginering
500 W Wood St
Palatine, IL 60067
847-991-6200

EPA ID: Not Reported
ERA Customer Number: C144861

Evaluation Checks

There are no values reported with < where the assigned value was greater than 0.

Not Acceptable Evaluations

There were no Not Acceptable evaluations for this study.

16341 Table Mountain Pkwy • Golden, CO 80403 • 800.3[illegible]22 • 303.431.8454 • fax 303.421.0159 • www.eraqc.com

ERA
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Final Report Results For Laboratory
Clean Air Enginering

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SSAP Evaluation Report

Project Number: **031214R**

ERA Customer Number: **C144861**

Laboratory Name: **Clean Air Enginering**

Inorganic Results

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031214R Evaluation Final Complete Report

ERA
A Waters Company

Doug Rhoades
Clean Air Enginering
500 W Wood St
Palatine, IL 60067
847-991-6200

EPA ID: Not Reported
ERA Customer Number: C144861

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Z Score	Study Mean	Study Standard Deviation	Analyst Name
SSAP Sulfuric Acid/Sulfur Dioxide in Impinger Solution (cat# 1144) Study Dates: 03/12/14 - 04/03/14												
4020	H2SO4	mg/dscm	26.35	26.0	23.4 - 28.6	Acceptable	EPA 8 2000	4/2/2014	0			Douglas Rhoades

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA OTM 029
Cyanide Laboratory Data Summary

Run No.		Blank	1	2	3	8
Date (2014)			Mar 18	Mar 18	Mar 19	Mar 21
Start Time (approx.)			10:45	17:56	09:14	08:23
Stop Time (approx.)			12:01	19:09	10:23	09:32

☐ DRAFT LAB DATA

MDL	Min. detectable limit (µg CN-/ml)	0.0289

HCN as Total Cyanide

B_i	Blank concentration (µg CN-/ml)	0.0000

v_1	Fraction 1 sample volume (ml)	1371.0	1679.0	1281.0	1095.0
v_2	Fraction 2 sample volume (ml)	151.0	151.0	162.0	166.0
m_a	HCN collected before blank subtraction (µg)	28676.000	29831.000	22410.000	26910.0000
m_b	Allowable blank subtraction (µg)	0.000	0.000	0.000	0.000
m_{nb}	HCN collected after blank subtraction (µg)	28676.000	29831.000	22410.000	26910.000
m_{MDL}	Minimum detectable HCN (µg)	45.657	54.897	43.287	37.828
m_n	*Total HCN used in emission calculations (µg)*	28676.000	29831.000	22410.000	26910.000
m_n	*Total HCN used in emission calculations (mg)*	28.676	29.831	22.410	26.910

051414 145950

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SS EPA26-1 Version 2006-10a-(Gen)

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Marathon
Clean Air Project No: 12461
FCCU Regenerator Vent

USEPA OTM 029
Cyanide Laboratory Data Summary

Run No.		Blank	4	5	6	7
Date (2014)			Mar 19	Mar 19	Mar 19	Mar 20
Start Time (approx.)			11:23	13:27	15:31	09:31
Stop Time (approx.)			12:32	14:38	16:41	11:11

☐ DRAFT LAB DATA

MDL	Min. detectable limit (µg CN-/ml)	0.0289

HCN as Total Cyanide

B_i	Blank concentration (µg CN-/ml)	0.0000

v_1	Fraction 1 sample volume (ml)	995.0	995.0	1224.0	1232.0
v_2	Fraction 2 sample volume (ml)	141.0	142.0	118.0	184.0
m_a	HCN collected before blank subtraction (µg)	17333.0000	20072.000	19903.000	18888.0000
m_b	Allowable blank subtraction (µg)	0.000	0.000	0.000	0.000
m_{nb}	HCN collected after blank subtraction (µg)	17333.000	20072.000	19903.000	18888.000
m_{MDL}	Minimum detectable HCN (µg)	34.078	34.108	40.258	42.477
m_n	*Total HCN used in emission calculations (µg)*	17333.000	20072.000	19903.000	18888.000
m_n	*Total HCN used in emission calculations (mg)*	17.333	20.072	19.903	18.888

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SS EPA26-1 Version 2006-10a-(Gen)

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Clean Air Engineering

321 Century Plaza, #130
Houston, TX 77073

Marathon
Garyville, LA
Client Project# 12461

Analytical Report
(0314-70)

EPA OTM-29
Hydrogen cyanide

Enthalpy Analytical, Inc.
Phone: (919) 850 - 4392 / Fax: (919) 850 - 9012 / www.enthalpy.com
800-1 Capitola Drive Durham, NC 27713-4385

I certify that to the best of my knowledge all analytical data presented in this report:

- Have been checked for completeness
- Are accurate, error-free, and legible
- Have been conducted in accordance with approved protocol, and that all deviations and analytical problems are summarized in the appropriate narrative(s)

This analytical report was prepared in Portable Document Format (.PDF) and contains 153 pages.

Kristen H Bounds

QA Reviewed by – Kristen H. Bounds

Report Issued: 04/09/2014

Summary of Results

Company	Clean Air Engineering
Analyst	AMP
Parameters	EPA OTM-29

Client #	12461
Job #	0314-70
# Samples	8 Runs, 4 Blanks, 1 Spike

Compound	Sample ID / Catch Weight (ug)		
	Run 1	***Run 2***	***Run 3***
Hydrogen cyanide	28,677	29,831	22,410
	Run 4	***Run 5***	***Run 6***
Hydrogen cyanide	17,333	20,072	19,903
	Run 7	***Run 8***	***Field Train Blank***
Hydrogen cyanide	18,888	26,910	113 ND
	Field Spike	***RB-6N NaOH***	***RB-0.1N NaOH***
Hydrogen cyanide	1,007	11.8 ND	2.89 ND

Results

Company	Clean Air Engineering
Analyst	AMP
Parameters	EPA OTM-29

Client #	12461
Job #	0314-70
# Samples	8 Runs, 4 Blanks, 1 Field Spike

MDL 0.0289 (ug/mL)
LOQ 0.100 (ug/mL)
Compound Hydrogen cyanide

Lower Curve Limit 0.100 (ug/mL)
Upper Curve Limit 1.97 (ug/mL)

Sample ID	Lab ID # 1	Lab ID # 2	Analysis Method	Ret Time (min)	Ret Time (min)	% Diff Ret	Conc # 1 (ug/mL)	Conc # 2 (ug/mL)	% Diff Conc	Avg Conc (ug/mL)	DF	Vol (mL)	Catch Weight (ug)	Qual
Run 1 Imp 1-3	24	25	HCN-Method	7.40	7.38	0.2	1.07	1.01	2.7	1.04	20	1,371	28,441	
Run 1 Imp 4	28	29	HCN-Method	7.42	7.42	0.0	0.309	0.315	1.0	0.312	5	151	235	
													28,677	
Run 2 Imp 1-3	30	31	HCN-Method	7.42	7.42	0.0	0.900	0.877	1.3	0.888	20	1,679	29,831	
Run 2 Imp 4	32	33	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	395	57.1	ND
													29,831	
Run 3 Imp 1-2	34	35	HCN-Method	7.43	7.43	0.0	1.47	1.51	1.6	1.49	20	720	21,451	
Run 3 Imp 3-4	20	21	HCN-Method	7.58	7.57	0.2	0.336	0.348	1.7	0.342	5	561	959	
Run 3 Imp 5	28	29	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	162	23.4	ND
													22,410	
Run 4 Imp 1-3	36	37	HCN-Method	7.55	7.57	0.2	0.871	0.871	0.0	0.871	20	995	17,333	
Run 4 Imp 4	38	39	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	141	20.4	ND
													17,333	
Run 5 Imp 1-2	40	41	HCN-Method	7.55	7.55	0.0	1.26	1.25	0.7	1.26	20	772	19,379	
Run 5 Imp 3-4	42	43	HCN-Method	7.57	7.60	0.4	0.280	0.279	0.1	0.279	5	496	693	
Run 5 Imp 5	44	45	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	142	20.5	ND
													20,072	

Company	Clean Air Engineering
Analyst	AMP
Parameters	EPA OTM-29

Client #	12461
Job #	0314-70
# Samples	8 Runs, 4 Blanks, 1 Field Spike

MDL 0.0289 (ug/mL)
LOQ 0.100 (ug/mL)
Compound Hydrogen cyanide

Lower Curve Limit 0.100 (ug/mL)
Upper Curve Limit 1.97 (ug/mL)

Sample ID	Lab ID # 1	Lab ID # 2	Analysis Method	Ret Time (min)	Ret Time (min)	% Diff Ret	Conc # 1 (ug/mL)	Conc # 2 (ug/mL)	% Diff Conc	Avg Conc (ug/mL)	DF	Vol (mL)	Catch Weight (ug)	Qual
Run 6 Imp 1-3	48	49	HCN-Method	7.68	7.52	2.2	1.06	1.10	1.8	1.08	20	920	19,903	
Run 6 Imp 4	50	51	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	304	43.9	ND
Run 6 Imp 5	52	53	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	118	17.1	ND
													19,903	
Run 7 Imp 1-2	54	55	HCN-Method	7.55	7.60	0.7	1.34	1.33	0.4	1.33	20	701	18,692	
Run 7 Imp 3-4	56	57	HCN-Method	7.70	7.67	0.4	0.0853	0.0619	15.9	0.074	5	531	195	J
Run 7 Imp 5	88	89	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	184	26.6	ND
													18,888	
Run 8 Imp 1-4	90	91	HCN-Method	7.40	7.45	0.7	1.22	1.23	0.4	1.23	20	1,095	26,910	
Run 8 Imp 5	92	93	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	166	24.0	ND
													26,910	
Field Train Blank Imp 1-4	94	95	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	781	113	ND
Field Train Blank Imp 5	96	97	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	149	21.5	ND
													113	ND
Field Spike	104	105	HCN-Method	7.48	7.58	1.3	1.48	1.53	1.5	1.50	5	134	1,007	
												Spike Amount (ug)	1,002	
												Spike Recovery (%)	100%	

Company	Clean Air Engineering
Analyst	AMP
Parameters	EPA OTM-29

Client #	12461
Job #	0314-70
# Samples	8 Runs, 4 Blanks, 1 Field Spike

MDL 0.0289 (ug/mL)
LOQ 0.100 (ug/mL)
Compound Hydrogen cyanide

Lower Curve Limit 0.100 (ug/mL)
Upper Curve Limit 1.97 (ug/mL)

Sample ID	Lab ID # 1	Lab ID # 2	Analysis Method	Ret Time (min)	Ret Time (min)	% Diff Ret	Conc # 1 (ug/mL)	Conc # 2 (ug/mL)	% Diff Conc	Avg Conc (ug/mL)	DF	Vol (mL)	Catch Weight (ug)	Qual
RB-6N NaOH	100	101	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	5	82.0	11.8	ND
RB-0.1N NaOH	102	103	HCN-Method	NA	NA	NA	0.0289	0.0289	NA	0.0289	1	100	2.89	ND
HPLC60PG190 #RB	14	15	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	1	1.00	0.0289	ND
HPLC60PG190 #RB	14	15	HCN-Method	NA	NA	NA	0.0289	0.0289	0.0	0.0289	1	1.00	0.0289	ND
MS / Run 1 Imp 1-3	16	17	HCN-Method	7.52	7.52	0.0	1.75	1.77	0.6	1.76	1	0.520	0.913	
												Spike Amount (ug)	0.361	
												Native Amount (ug)	0.519	
												Spike Recovery (%)	109%	
MSD / Run 1 Imp 1-3	18	19	HCN-Method	7.58	7.78	2.6	1.77	1.84	2.0	1.81	1	0.520	0.940	
												Spike Amount (ug)	0.361	
												Native Amount (ug)	0.519	
												Spike Recovery (%)	116%	
MS / Run 3 Imp 3-4	62	63	HCN-Method	7.50	7.50	0.0	1.01	1.04	1.5	1.02	1	0.520	0.532	
												Spike Amount (ug)	0.361	
												Native Amount (ug)	0.171	
												Spike Recovery (%)	99.9%	

Company	Clean Air Engineering
Analyst	AMP
Parameters	EPA OTM-29

Client #	12461
Job #	0314-70
# Samples	8 Runs, 4 Blanks, 1 Field Spike

MDL 0.0289 (ug/mL)
LOQ 0.100 (ug/mL)
Compound Hydrogen cyanide

Lower Curve Limit 0.100 (ug/mL)
Upper Curve Limit 1.97 (ug/mL)

Sample ID	Lab ID # 1	Lab ID # 2	Analysis Method	Ret Time (min)	Ret Time (min)	% Diff Ret	Conc # 1 (ug/mL)	Conc # 2 (ug/mL)	% Diff Conc	Avg Conc (ug/mL)	DF	Vol (mL)	Catch Weight (ug)	Qual
MSD / Run 3 Imp 3-4	26	27	HCN-Method	7.53	7.55	0.2	1.03	1.05	0.7	1.04	1	0.520	0.541	
												Spike Amount (ug)	0.361	
												Native Amount (ug)	0.171	
												Spike Recovery (%)	102%	
MS / Run 3 Imp 5	30	31	HCN-Method	7.70	7.53	2.2	0.799	0.813	0.9	0.806	1	0.520	0.419	
												Spike Amount (ug)	0.361	
												Native Amount (ug)	0.000	
												Spike Recovery (%)	116%	
MSD / Run 3 Imp 5	32	33	HCN-Method	7.58	7.55	0.5	0.797	0.829	2.0	0.813	1	0.520	0.423	
												Spike Amount (ug)	0.361	
												Native Amount (ug)	0.000	
												Spike Recovery (%)	117%	
AQ LCS-1	106	107	HCN-Method	7.55	7.57	0.2	1.08	1.08	0.1	1.08	1,000	1.00	1,079	
												Spike Amount (ug)	1,002	
												Spike Recovery (%)	108%	
AQ LCS-2	108	109	HCN-Method	7.52	7.60	1.1	0.908	1.052	7.3	0.980	1,000	1.00	980	
												Spike Amount (ug)	1,002	
												Spike Recovery (%)	97.8%	

Narrative Summary

Enthalpy Analytical Narrative Summary

Company	Clean Air Engineering
Analyst	AMP
Parameters	EPA OTM-29

Client #	12461
Job #	0314-70
# Samples	8 Runs, 4 Blanks, 1 Spike

Custody

Chester Burnett of Enthalpy Analytical, Inc. received the samples on 3/26/14 at 10.9°C after being relinquished by Clean Air Engineering. The samples were received in good condition. Prior to, during, and after analysis, the samples were kept under lock with access only to authorized personnel by Enthalpy Analytical, Inc.

Analysis

The samples were analyzed for hydrogen cyanide using the analytical procedures in EPA OTM-29, Sampling and Analysis For Hydrogen Cyanide Emissions From Stationary Sources.

For ***Run 1*** and ***Run 2***, proportional aliquots were taken from each of the Imp 1-3 bottles and combined for a single fraction analysis.

The pH of each container was measured and recorded prior to analysis. All containers had pH values $\geq$ 12.

The ICS-3000 Ion Chromatograph "Flanders" was used for these analyses.

Calibration

The calibration curves are included in the Raw Data section. The first page of the curve shows a graphical representation of the curve, and the following pages show some of the instrument parameters and the amounts (concentrations) for the associated standard levels used to make the curve. The calibration table is used to identify (by retention time) and quantify each target compound.

Chromatographic Conditions

The acquisition method (HCN-Back.M) is included in the Raw Data section of this report.

QC Notes

All samples were analyzed within the 30-day holding time specified by the method.

The analyses of the client blanks and the laboratory reagent blank showed no hydrogen cyanide at levels greater than the detection limit.

Duplicate matrix spikes were prepared using aliquots of samples ***Run 1 Imp1-3, Run 3 Imp3-4, and Run 3 Imp5.*** The matrix spikes exhibited recovery values ranging from 99.9% to 117%.

Enthalpy Analytical Narrative Summary
(continued)

QC Notes (continued)

Prior to sample collection, six aqueous spikes were made containing 1,002 µg of hydrogen cyanide. Four of these spikes were sent to the client and two were retained for use as Laboratory Control Samples (LCSs). The LCSs were analyzed along with the samples and yielded percent recovery values of 108% and 97.8%. ***LCS-2*** did not meet our in-house reproducability requirements of ±5% of the injections' mean.

Reporting Notes

These analyses met the requirements of the TNI Standard. Any deviations from the requirements of the reference method or TNI Standard have been stated above.

The results presented in this report are representative of the samples as provided to the laboratory.

General Reporting Notes

The following are general reporting notes that are applicable to all Enthalpy Analytical, Inc. data reports, unless specifically noted otherwise.

- Any analysis which refers to the method as ***"Type"*** represents a planned deviation from the reference method. For instance a Hydrogen Sulfide assay from a Tedlar bag would be labeled as "EPA Method 16-Type" because Tedlar bags are not mentioned as one of the collection options in EPA Method 16.
- The acronym ***MDL*** represents the Minimum Detection Limit. Below this value the laboratory cannot determine the presence of the analyte of interest reliably.
- The acronym ***LOQ*** represents the Limit of Quantification. Below this value the laboratory cannot quantitate the analyte of interest within the criteria of the method.
- The acronym ***ND*** following a value indicates a non-detect or analytical result below the MDL.
- The letter ***J*** in the Qualifier or Flag column in the results indicates that the value is between the MDL and the LOQ. The laboratory can positively identify the analyte of interest as present, but the value should be considered an estimate.
- The letter ***E*** in the Qualifier or Flag column indicates an analytical result exceeding 100% of the highest calibration point. The associated value should be considered as an estimate.
- The acronym ***DF*** represents Dilution Factor. This number represents dilution of the sample during the preparation and/or analysis process. The analytical result taken from a laboratory instrument is multiplied by the DF to determine the final undiluted sample results.
- The addition of ***MS*** to the Sample ID represents a Matrix Spike. An aliquot of an actual sample is spiked with a known amount of analyte so that a percent recovery value can be determined. The MS analysis indicates what effect the sample matrix may have on the target analyte, i.e. whether or not anything in the sample matrix interferes with the analysis of the analyte(s).
- The addition of ***MSD*** to the Sample ID represents a Matrix Spike Duplicate. Prepared in the same manner as a MS, the use of duplicate matrix spikes allows further confirmation of laboratory quality by showing the consistency of results gained by performing the same steps multiple times.
- The addition of ***LD*** to the Sample ID represents a Laboratory Duplicate. The analyst prepares an additional aliquot of sample for testing and the results of the duplicate analysis are compared to the initial result. The result should have a difference value of within 10% of the initial result (if the results of the original analysis are greater than the LOQ).
- The addition of ***AD*** to the Sample ID represents an Alternate Dilution. The analyst prepares an additional aliquot at a different dilution factor (usually double the initial factor). This analysis helps confirm that no additional compound is present and coeluting or sharing absorbance with the analyte of interest, as they would have a different response/absorbance than the analyte of interest.

General Reporting Notes

(continued)

- The Sample ID ***LCS*** represents a Laboratory Control Sample. Clean matrix, similar to the client sample matrix, prepared and analyzed by the laboratory using the same reagents, spiking standards and procedures used for the client samples. The LCS is used to assess the control of the laboratory's analytical system. Whenever spikes are prepared for our client projects, two spikes are retained as LCSs. The LCSs are labeled with the associated project number and kept in-house at the appropriate temperature conditions. When the project samples are received for analysis, the LCSs are analyzed to confirm that the analyte could be recovered from the media, separate from the samples which were used on the project and which may have been affected by source matrix, sample collection and/or sample transport.

- **Significant Figures**: Where the reported value is much greater than unity (1.00) in the units expressed, the number is rounded to a whole number of units, rather than to 3 significant figures. For example, a value of 10,456.45 ug catch is rounded to 10,456 ug. There are five significant digits displayed, but no confidence should be placed on more than two significant digits.

- **Manual Integration**: The data systems used for processing will flag manually integrated peaks with an "M". There are several reasons a peak may be manually integrated. These reasons will be identified by the following two letter designations on sample chromatograms, if provided in the report. The peak was ***not integrated*** by the software **"NI"**, the peak was ***integrated incorrectly*** by the software **"II"** or the ***wrong peak*** was integrated by the software **"WP"**. These codes will accompany the analyst's manual integration stamp placed next to the compound name on the chromatogram.

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MONITOR DATA

H

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: PWK

Date: 05/14

CleanAir

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU

March 20, 2014
Start Time 8:28
Stop Time 8:58

CALIBRATION ERROR

	Channel 1	Channel 2	Channel 3
	O2	CO2	THC
	FCCU	FCCU	FCCU
	%dv	%dv	ppmwv
Instrument Information			
Manufacturer:	Servomex	Servomex	JUM
Model:	1420C	1415C	Heaated
Detection:	Paramagn.	NDIR	FID 3-500
Asset or Serial No:	207363	207493	208483
Calibration Span Value (CS)			
	9.050	19.000	85.600
System Response Time (seconds)			
Manufacturer Certified Cylinder Value (C_V)			
Zero	0.000	0.000	0.000
Low	4.540	9.140	24.700
Mid			45.400
High	9.050	19.000	85.600
Actual gas to be used for bias checks			
	4.540	19.000	24.700
Cylinder ID			
Zero	0114	0114	ALM054299
Low	0710	ALM23687	0810
Mid			AL1816
High	ALM23687	0710	ALM010763
Analyzer Calibration Response (C_{Dir})			
Zero	0.001	0.043	-0.833
Low	4.545	8.955	24.181
Mid	N/A	N/A	44.879
High	9.039	19.082	85.343
Analyzer Calibration Error (ACE) (Limit = 2%, Method 25A limit = 5% of gas val			
Zero	0.0%	0.2%	-1.0%
Low	0.1%	-1.0%	-2.1%
Mid	N/A	N/A	-1.1%
High	-0.1%	0.4%	-0.3%
Calibration Error Status			
Zero	OK	OK	OK
Low	OK	OK	OK
Mid	N/A	N/A	OK
High	OK	OK	OK

050514 174150			
08:28:02	0.479	-0.041	2.789
08:28:17	0.081	-0.072	2.787
08:28:32	0.036	-0.079	2.789
08:28:47	-0.008	-0.069	2.794
08:29:02	-0.030	-0.012	2.792
08:29:17	0.008	0.000	2.829
08:29:32	0.004	0.004	2.825
08:29:47	-0.255	-0.082	2.691
08:30:02	-1.923	-0.188	2.362
08:30:17	-0.001	0.002	2.766
08:30:32	-0.006	0.000	2.764

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU

	March 20, 2014
Start Time	8:28
Stop Time	8:58

CALIBRATION ERROR

	Channel 1 O2	Channel 2 CO2	Channel 3 THC
	FCCU %dv	FCCU %dv	FCCU ppmwv
08:30:47	-0.007	0.000	2.777
08:31:02	-0.008	0.001	2.772
08:31:17	0.404	0.002	2.766
08:31:32	7.244	1.943	2.753
08:31:47	8.958	7.462	2.776
08:32:02	9.046	8.991	2.758
08:32:17	9.059	9.060	2.780
08:32:32	9.064	9.088	2.779
08:32:47	9.066	9.108	2.748
08:33:02	9.064	9.104	2.735
08:33:17	9.065	9.095	2.766
08:33:32	9.062	9.086	2.756
08:33:47	6.849	10.630	2.738
08:34:02	4.683	15.903	2.746
08:34:17	4.549	17.188	2.782
08:34:32	4.560	18.248	2.769
08:34:47	4.565	18.667	2.764
08:35:02	4.555	18.802	2.784
08:35:17	4.549	18.842	2.758
08:35:32	4.549	18.952	2.764
08:35:47	4.545	19.090	2.774
08:36:02	4.548	19.165	2.746
08:36:17	4.547	19.245	2.753
08:36:32	4.545	19.279	2.746
08:36:47	4.542	19.086	2.751
08:37:02	4.544	19.064	2.757
08:37:17	4.548	19.096	2.766
08:37:32	4.551	19.117	2.758
08:37:47	7.477	13.525	2.745
08:38:02	8.934	9.151	2.745
08:38:17	9.015	9.057	2.741
08:38:32	9.028	9.026	2.771
08:38:47	9.030	8.984	2.756
08:39:02	9.032	8.963	2.738
08:39:17	9.036	8.954	2.730
08:39:32	9.040	8.952	2.750
08:39:47	9.042	8.958	2.741
08:40:02	4.097	5.493	2.740
08:40:17	0.249	0.448	2.745
08:40:32	0.042	0.112	2.750
08:40:47	0.015	0.070	2.767
08:41:02	0.004	0.052	2.706
08:41:17	0.000	0.044	2.719
08:41:32	-0.002	0.031	2.729
08:41:47	-0.006	0.031	2.721
08:44:53	0.208	0.003	1.911
08:45:08	0.114	0.001	1.913
08:45:23	0.087	0.000	1.911
08:45:38	0.074	0.000	1.913
08:45:53	0.065	0.000	1.916
08:46:08	0.057	0.000	1.965
08:46:23	1.426	3.704	2.048
08:46:38	4.121	16.047	2.050
08:46:53	4.504	18.514	2.053

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU

March 20, 2014
Start Time 8:28
Stop Time 8:58

CALIBRATION ERROR

	Channel 1	Channel 2	Channel 3
	O2	CO2	THC
	FCCU	FCCU	FCCU
	%dv	%dv	ppmwv
08:47:08	4.549	18.834	2.056
08:47:23	4.561	18.906	2.059
08:47:38	4.563	18.948	2.063
08:47:53	4.559	18.971	2.066
08:48:08	4.562	18.994	2.066
08:48:23	4.560	19.016	2.066
08:48:38	5.593	18.521	2.239
08:48:53	16.298	6.300	2.821
08:49:08	20.302	0.828	2.797
08:49:23	20.762	0.242	2.838
08:49:38	20.828	0.156	2.435
08:49:53	20.851	0.120	0.106
08:50:08	20.865	0.107	0.029
08:50:23	20.874	0.089	0.042
08:50:38	20.874	0.085	-0.041
08:50:53	20.667	0.125	17.037
08:51:08	20.130	0.381	83.948
08:51:23	20.504	0.236	84.436
08:51:38	20.724	0.055	84.834
08:51:53	20.749	0.031	85.433
08:52:08	20.755	0.028	85.439
08:52:23	20.757	0.019	85.350
08:52:38	20.758	0.020	85.325
08:52:53	20.759	0.018	85.335
08:53:08	20.762	0.012	85.368
08:53:23	20.767	0.013	20.120
08:53:38	20.940	0.018	-0.480
08:53:53	21.040	0.010	-0.666
08:54:08	21.054	0.010	-0.746
08:54:23	21.055	0.006	-0.784
08:54:38	21.056	0.007	-0.814
08:54:53	21.055	0.006	-0.837
08:55:08	21.058	0.006	-0.850
08:55:23	21.056	0.006	19.077
08:55:38	20.764	0.011	44.676
08:55:53	20.367	0.006	44.879
08:56:08	20.315	0.006	44.830
08:56:23	20.309	0.003	44.927
08:56:38	20.307	0.001	41.364
08:56:53	20.353	0.006	24.285
08:57:08	20.651	0.003	24.168
08:57:23	20.725	0.002	24.158
08:57:38	20.735	0.003	24.163
08:57:53	20.736	0.000	24.160
08:58:08	20.736	0.001	24.220

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU

March 20, 2014
Start Time 8:44
Stop Time 8:58

CALIBRATION BIAS 00

		Channel 1 O2	Channel 2 CO2	Channel 3 THC
		FCCU %dv	FCCU %dv	FCCU ppmwv
System Response to Calibration Gasses (C_S)				
C_{cf}	Zero gas	0.065	0.000	-0.833
C_{uf}	Upscale gas	4.560	18.994	24.181
Analyzer Calibration Error Reponses (C_{Dir})				
C_{oce}	Zero gas	0.001	0.043	-0.833
C_{mce}	Upscale gas	4.545	19.082	24.181
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.7%	-0.2%	0.0%
	Upscale gas	0.2%	-0.5%	0.0%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	N/A	N/A	N/A
C_{ui}	Upscale gas	N/A	N/A	N/A
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	N/A	N/A	N/A
	Upscale gas	N/A	N/A	N/A
Drift Assessment Status				
	Zero gas	N/A	N/A	N/A
	Upscale gas	N/A	N/A	N/A

050514 174150

08:44:53	0.208	0.003	1.911
08:45:08	0.114	0.001	1.913
08:45:23	0.087	0.000	1.911
08:45:38	0.074	0.000	1.913
08:45:53	0.065	0.000	1.916
08:46:08	0.057	0.000	1.965
08:46:23	1.426	3.704	2.048
08:46:38	4.121	16.047	2.050
08:46:53	4.504	18.514	2.053
08:47:08	4.549	18.834	2.056
08:47:23	4.561	18.906	2.059
08:47:38	4.563	18.948	2.063
08:47:53	4.559	18.971	2.066
08:48:08	4.562	18.994	2.066
08:48:23	4.560	19.016	2.066
08:48:38	5.593	18.521	2.239
08:48:53	16.298	6.300	2.821
08:49:08	20.302	0.828	2.797
08:49:23	20.762	0.242	2.838
08:49:38	20.828	0.156	2.435
08:49:53	20.851	0.120	0.106
08:50:08	20.865	0.107	0.029
08:50:23	20.874	0.089	0.042
08:50:38	20.874	0.085	-0.041
08:50:53	20.667	0.125	17.037
08:51:08	20.130	0.381	83.948
08:51:23	20.504	0.236	84.436
08:51:38	20.724	0.055	84.834

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU

March 20, 2014
Start Time 8:44
Stop Time 8:58

CALIBRATION BIAS 00

	Channel 1 O2	Channel 2 CO2	Channel 3 THC
	FCCU %dv	FCCU %dv	FCCU ppmwv
08:51:53	20.749	0.031	85.433
08:52:08	20.755	0.028	85.439
08:52:23	20.757	0.019	85.350
08:52:38	20.758	0.020	85.325
08:52:53	20.759	0.018	85.335
08:53:08	20.762	0.012	85.368
08:53:23	20.767	0.013	20.120
08:53:38	20.940	0.018	-0.480
08:53:53	21.040	0.010	-0.666
08:54:08	21.054	0.010	-0.746
08:54:23	21.055	0.006	-0.784
08:54:38	21.056	0.007	-0.814
08:54:53	21.055	0.006	-0.837
08:55:08	21.058	0.006	-0.850
08:55:23	21.056	0.006	19.077
08:55:38	20.764	0.011	44.676
08:55:53	20.367	0.006	44.879
08:56:08	20.315	0.006	44.830
08:56:23	20.309	0.003	44.927
08:56:38	20.307	0.001	41.364
08:56:53	20.353	0.006	24.285
08:57:08	20.651	0.003	24.168
08:57:23	20.725	0.002	24.158
08:57:38	20.735	0.003	24.163
08:57:53	20.736	0.000	24.160
08:58:08	20.736	0.001	24.220

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Marathon
CleanAir Project No. 12461
Garyville, LA
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March 20, 2014
Start Time 9:07
Stop time 10:17

REFERENCE METHOD RUN 1

		Channel 1 O2 FCCU %dv	Channel 2 CO2 FCCU %dv	Channel 3 THC FCCU ppmwv
Calibration Checks				
C_{oi}	Initial zero	0.065	0.000	-0.833
C_{ui}	Initial upscale	4.560	18.994	24.181
C_{of}	Final zero	0.003	0.056	-0.320
C_{uf}	Final upscale	4.507	19.085	25.309
C_{ma}	Actual gas value	4.540	19.000	24.700
Analyzer Averages (concentrations)				
C_{Avg}	Average conc.	1.279	18.810	3.068
C_{Gas}	Bias adjusted	**1.256**	**18.771**	**3.555**

Clock Time (at end of sample period)				
050514 174150				
09:08	1.635	18.435	2.222	
09:09	1.369	18.650	2.878	
09:10	1.273	18.775	3.186	
09:11	1.246	18.804	3.816	
09:12	1.253	18.779	3.969	
09:13	1.404	18.711	4.009	
09:14	1.568	18.503	3.975	
09:15	1.572	18.524	3.900	
09:16	1.357	18.644	3.861	
09:17	1.177	18.802	3.832	
09:18	1.020	18.993	3.814	
09:19	1.080	18.983	3.716	
09:20	1.397	18.704	3.685	
09:21	1.350	18.696	3.597	
09:22	8.523	12.519	2.408	out of duct for port changes
09:24	20.851	0.111	0.587	
09:25	13.402	6.566	1.818	
09:26	1.297	18.716	3.134	Back in the stack
09:27	1.183	18.835	3.342	
09:28	1.338	18.745	3.404	
09:29	1.182	18.844	3.369	
09:30	0.970	19.055	3.359	
09:31	0.998	19.070	3.370	
09:32	1.077	18.973	3.310	
09:33	1.091	18.974	3.362	
09:34	1.095	18.991	3.238	
09:35	1.074	19.002	3.192	
09:36	1.045	18.962	3.179	
09:37	1.071	18.973	3.184	
09:38	1.096	18.943	3.103	
09:39	1.303	18.810	3.085	
09:40	1.275	18.796	3.043	
09:41	1.409	18.726	3.017	
09:42	1.943	18.217	2.982	
09:43	1.603	18.450	2.938	
09:44	1.212	18.811	2.989	
09:45	0.978	19.043	3.001	
09:46	1.249	18.833	2.927	
09:47	1.374	18.763	2.878	
09:48	1.195	18.877	2.895	

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU

March 20, 2014
Start Time 9:07
Stop time 10:17

REFERENCE METHOD RUN 1

	Channel 1 O2	Channel 2 CO2	Channel 3 THC	
	FCCU %dv	FCCU %dv	FCCU ppmwv	
09:49	1.403	18.755	2.850	
09:50	2.231	18.103	2.867	port change
09:51	1.978	18.015	2.892	
09:52	1.479	18.635	2.775	
09:53	1.372	18.743	2.827	
09:54	1.226	18.844	2.807	
09:55	1.175	18.938	2.858	
09:56	1.389	18.764	2.807	
09:57	1.386	18.739	2.820	
09:58	1.397	18.732	2.773	
09:59	1.312	18.789	2.814	
10:00	1.361	18.737	2.837	
10:01	1.329	18.780	2.778	
10:02	1.125	18.971	2.777	
10:03	1.324	18.809	2.804	
10:04	1.170	18.879	2.811	
10:05	0.973	19.110	2.794	
10:06	1.148	18.952	2.796	
10:07	1.112	18.995	2.777	
10:08	1.402	18.760	2.836	
10:09	1.255	18.857	2.717	
10:10	1.217	18.887	2.728	
10:11	1.458	18.693	2.741	
10:12	1.246	18.854	2.733	
10:13	1.311	18.851	2.727	
10:14	1.214	18.890	2.714	
10:15	1.104	18.997	2.740	
10:16	0.995	19.078	2.748	
10:17	0.974	19.130	2.720	

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Marathon
CleanAir Project No. 12461
Garyville, LA
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March 20, 2014
Start Time 10:20
Stop Time 10:27

CALIBRATION BIAS 01

		Channel 1 O2	Channel 2 CO2	Channel 3 THC
		FCCU %dv	FCCU %dv	FCCU ppmwv
System Response to Calibration Gasses (C_S)				
C_{of}	Zero gas	0.003	0.056	-0.320
C_{uf}	Upscale gas	4.507	19.085	25.309
Analyzer Calibration Error Reponses (C_{Dir})				
C_{oco}	Zero gas	0.001	0.043	-0.833
C_{mco}	Upscale gas	4.545	19.082	24.181
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.0%	0.1%	0.6%
	Upscale gas	-0.4%	0.0%	1.3%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	0.065	0.000	-0.833
C_{ui}	Upscale gas	4.560	18.994	24.181
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	-0.7%	0.3%	0.6%
	Upscale gas	-0.6%	0.5%	1.3%
Drift Assessment Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK

050514 174150

10:20:49	0.006	0.067	0.251
10:21:04	0.003	0.053	0.182
10:21:19	0.000	0.049	0.114
10:21:34	-0.152	0.031	-0.049
10:21:49	-2.998	0.477	0.062
10:22:04	3.808	13.680	0.078
10:22:19	4.462	18.527	0.018
10:22:34	4.491	18.925	-0.032
10:22:49	4.504	19.016	-0.073
10:23:04	4.506	19.032	-0.119
10:23:19	4.507	19.053	-0.166
10:23:34	4.507	19.068	-0.194
10:23:49	4.512	19.094	-0.231
10:24:04	4.501	19.094	0.462
10:24:19	7.762	16.849	25.771
10:24:34	19.125	2.797	23.821
10:24:49	20.517	0.325	24.366
10:25:04	20.614	0.183	25.345
10:25:19	20.639	0.127	25.301
10:25:34	20.656	0.106	25.278
10:25:49	20.671	0.085	25.348
10:26:04	20.664	0.083	6.903
10:26:19	20.776	0.095	-0.265
10:26:34	20.978	0.056	-0.325
10:26:49	21.014	0.049	-0.368
10:27:04	21.020	0.047	0.186

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Garyville, LA
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March 20, 2014
Start Time 8:28
Stop Time 8:58

CALIBRATION ERROR 02

	Channel 1	Channel 2	Channel 3
	O2	CO2	THC
	FCCU	FCCU	FCCU
	%dv	%dv	ppmwv
Instrument Information			
Manufacturer:	Servomex	Servomex	JUM
Model:	1420C	1415C	Heaated
Detection:	Paramagn.	NDIR	FID 3-500
Asset or Serial No:	207363	207493	208483
Calibration Span Value (CS)			
	9.050	19.000	85.600
System Response Time (seconds)			
Manufacturer Certified Cylinder Value (C_V)			
Zero	0.000	0.000	0.000
Low	4.540	9.140	24.700
Mid			45.400
High	9.050	19.000	85.600
Actual gas to be used for bias checks			
	4.540	19.000	24.700
Cylinder ID			
Zero	0114	0114	ALM054299
Low	0710	ALM23687	0810
Mid			AL1816
High	ALM23687	0710	ALM010763
Analyzer Calibration Response (C_{Dir})			
Zero	0.001	0.043	0.026
Low	4.545	8.955	24.602
Mid	N/A	N/A	44.966
High	9.039	19.082	85.585
Analyzer Calibration Error (ACE) (Limit = 2%, Method 25A limit = 5% of gas val			
Zero	0.0%	0.2%	0.0%
Low	0.1%	-1.0%	-0.4%
Mid	NA	NA	-1.0%
High	-0.1%	0.4%	0.0%
Calibration Error Status			
Zero	OK	OK	OK
Low	OK	OK	OK
Mid	NA	NA	OK
High	OK	OK	OK

050514 174150			
12:58:52	21.046	-0.005	0.109
12:59:07	21.047	0.000	0.130
12:59:22	21.048	-0.001	0.122
12:59:37	21.025	-0.004	74.050
12:59:52	20.811	0.000	89.924
13:00:07	20.757	-0.002	90.074
13:00:22	20.755	-0.001	86.287
13:00:37	20.754	0.000	85.644
13:00:52	20.755	-0.002	85.582
13:01:07	20.754	-0.001	85.529
13:01:22	20.763	0.000	22.419

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Marathon
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Garyville, LA
FCCU

March 20, 2014
Start Time 8:28
Stop Time 8:58

CALIBRATION ERROR 02

	Channel 1 O2	Channel 2 CO2	Channel 3 THC
	FCCU %dv	FCCU %dv	FCCU ppmwv
13:01:37	20.972	-0.001	0.389
13:01:52	21.043	0.000	0.033
13:02:07	21.048	0.000	0.045
13:02:22	21.046	-0.002	0.000
13:02:37	20.986	0.000	34.048
13:02:52	20.407	0.000	44.912
13:03:07	20.303	-0.001	44.985
13:03:22	20.297	0.000	45.001
13:03:37	20.299	-0.002	42.912
13:03:52	20.400	0.002	24.842
13:04:07	20.685	0.003	24.630
13:04:22	20.716	0.000	24.604
13:04:37	20.692	0.000	24.573

O2/CO2 Values from previous calibration

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU

March 20, 2014
Start Time 8:44
Stop Time 13:04

Calibration Bias 01b

		Channel 1 O2	Channel 2 CO2	Channel 3 THC
		FCCU %dv	FCCU %dv	FCCU ppmwv
System Response to Calibration Gasses (C_S)				
C_{of}	Zero gas	0.065	0.000	-0.114
C_{uf}	Upscale gas	4.560	18.994	24.692
Analyzer Calibration Error Reponses (C_{Dir})				
C_{oce}	Zero gas	0.001	0.043	0.026
C_{mce}	Upscale gas	4.545	19.082	24.602
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.7%	-0.2%	-0.2%
	Upscale gas	0.2%	-0.5%	0.1%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	N/A	N/A	N/A
C_{ui}	Upscale gas	N/A	N/A	N/A
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	N/A	N/A	N/A
	Upscale gas	N/A	N/A	N/A
Drift Assessment Status				
	Zero gas	N/A	N/A	N/A
	Upscale gas	N/A	N/A	N/A

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12:41:52	20.868	0.063	79.521
12:42:07	20.877	0.062	82.134
12:42:22	20.869	0.067	86.085
12:42:37	20.863	0.072	90.558
12:42:52	20.866	0.072	12.550
12:43:07	20.872	0.063	9.158
12:43:22	20.862	0.071	7.862
12:43:37	20.862	0.073	0.637
12:43:52	20.862	0.073	-0.190
12:44:07	20.856	0.079	-0.117
12:44:22	20.857	0.073	-0.034
12:44:37	20.863	0.069	-0.207
12:44:52	20.863	0.069	-0.244
12:45:07	20.867	0.067	0.371
12:45:22	20.868	0.069	0.427
12:45:37	20.867	0.067	0.444
12:45:52	20.868	0.064	0.368
12:46:07	20.868	0.066	0.228
12:46:22	20.865	0.065	0.339
12:46:37	20.871	0.061	-0.098
12:46:52	20.871	0.065	-0.306
12:47:07	20.872	0.061	-0.371
12:47:22	20.872	0.061	-0.410
12:47:37	20.873	0.061	-0.303
12:47:52	20.873	0.059	-0.112
12:48:07	20.871	0.059	-0.208
12:48:22	20.871	0.060	-0.213
12:48:37	20.875	0.059	-0.197

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Marathon
CleanAir Project No. 12461
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Start Time 8:44
Stop Time 13:04

Calibration Bias 01b

	Channel 1 O2	Channel 2 CO2	Channel 3 THC
	FCCU %dv	FCCU %dv	FCCU ppmwv
12:48:52	20.871	0.061	-0.109
12:49:07	20.873	0.059	-0.021
12:49:22	20.874	0.061	0.107
12:49:37	20.870	0.061	0.072
12:49:52	20.876	0.060	0.101
12:50:07	20.875	0.061	0.060
12:50:22	20.870	0.061	0.055
12:50:37	20.873	0.061	0.142
12:50:52	20.872	0.061	0.081
12:51:07	20.873	0.061	0.002
12:51:22	20.879	0.061	-1.296
12:51:37	20.920	0.053	-1.579
12:51:52	20.907	0.050	26.147
12:52:07	20.514	0.023	40.738
12:52:22	20.317	0.002	40.794
12:52:37	20.305	-0.002	40.795
12:52:52	20.301	0.000	41.490
12:53:07	20.292	0.025	79.982
12:53:22	20.662	0.024	81.597
12:53:37	20.749	0.000	81.709
12:53:52	20.750	-0.003	81.783
12:54:07	20.753	-0.003	82.017
12:54:22	20.756	0.000	82.053
12:54:37	20.757	-0.006	82.112
12:54:52	20.750	-0.003	82.185
12:55:07	20.752	-0.002	82.294
12:55:22	20.753	-0.006	84.664
12:55:37	20.753	-0.035	85.340
12:55:52	20.606	-0.024	85.315
12:56:07	20.623	-0.038	85.491
12:56:22	20.755	-0.001	85.384
12:56:37	20.755	-0.001	64.117
12:56:52	20.696	-0.001	21.324
12:57:07	20.718	0.000	21.016
12:57:22	20.722	-0.002	10.455
12:57:37	20.865	-0.001	-5.101
12:57:52	21.033	0.000	-5.221
12:58:07	21.049	-0.004	-5.089
12:58:22	21.051	-0.003	-0.589
12:58:37	21.048	-0.001	-0.023
12:58:52	21.046	-0.005	0.109
12:59:07	21.047	0.000	0.130
12:59:22	21.048	-0.001	0.122
12:59:37	21.025	-0.004	74.050
12:59:52	20.811	0.000	89.924
13:00:07	20.757	-0.002	90.074
13:00:22	20.755	-0.001	86.287
13:00:37	20.754	0.000	85.644
13:00:52	20.755	-0.002	85.582
13:01:07	20.754	-0.001	85.529
13:01:22	20.763	0.000	22.419
13:01:37	20.972	-0.001	0.389
13:01:52	21.043	0.000	0.033
13:02:07	21.048	0.000	0.045
13:02:22	21.046	-0.002	0.000
13:02:37	20.986	0.000	34.048
13:02:52	20.407	0.000	44.912
13:03:07	20.303	-0.001	44.985

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CleanAir Project No. 12461
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March 20, 2014
Start Time 8:44
Stop Time 13:04

Calibration Bias 01b

	Channel 1 O2	Channel 2 CO2	Channel 3 THC
	FCCU %dv	FCCU %dv	FCCU ppmwv
13:03:22	20.297	0.000	45.001
13:03:37	20.299	-0.002	42.912
13:03:52	20.400	0.002	24.842
13:04:07	20.685	0.003	24.630
13:04:22	20.716	0.000	24.604
13:04:37	20.692	0.000	24.573
08:44:53	0.208	0.003	1.911
08:45:08	0.114	0.001	1.913
08:45:23	0.087	0.000	1.911
08:45:38	0.074	0.000	1.913
08:45:53	0.065	0.000	1.916
08:46:08	0.057	0.000	1.965
08:46:23	1.426	3.704	2.048
08:46:38	4.121	16.047	2.050
08:46:53	4.504	18.514	2.053
08:47:08	4.549	18.834	2.056
08:47:23	4.561	18.906	2.059
08:47:38	4.563	18.948	2.063
08:47:53	4.559	18.971	2.066
08:48:08	4.562	18.994	2.066
08:48:23	4.560	19.016	2.066
08:48:38	5.593	18.521	2.239

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March 20, 2014
Start Time 13:07
Stop time 14:09

REFERENCE METHOD RUN 2

		Channel 1 O2 FCCU %dv	Channel 2 CO2 FCCU %dv	Channel 3 THC FCCU ppmwv
Calibration Checks				
C_{oi}	Initial zero	0.065	0.000	-0.114
C_{ui}	Initial upscale	4.560	18.994	24.692
C_{of}	Final zero	0.009	0.082	0.050
C_{uf}	Final upscale	4.492	19.028	25.865
C_{ma}	Actual gas value	4.540	19.000	24.700
Analyzer Averages (concentrations)				
C_{Avg}	Average conc.	1.201	18.843	3.150
C_{Gas}	**Bias adjusted**	**1.176**	**18.831**	**3.105**

Clock Time (at end of sample period)			
050514 174150			
13:08	1.342	18.708	3.419
13:09	1.490	18.601	3.463
13:10	1.105	18.869	3.549
13:11	0.918	19.047	3.612
13:12	0.844	19.156	3.562
13:13	0.982	19.098	3.494
13:14	1.253	18.820	3.468
13:15	1.291	18.780	3.390
13:16	1.294	18.796	3.319
13:17	1.098	18.825	3.308
13:18	0.994	19.016	3.346
13:19	1.136	18.948	3.374
13:20	1.537	18.617	3.327
13:21	1.328	18.703	3.262
13:22	1.336	18.712	3.284
13:23	1.225	18.824	3.298
13:24	1.124	18.902	3.230
13:25	1.252	18.835	3.240
13:26	1.217	18.831	3.232
13:27	1.139	18.911	3.187
13:28	1.359	18.739	3.153
13:29	1.362	18.695	3.148
13:30	1.144	18.881	3.132
13:31	1.211	18.811	3.228
13:32	1.310	18.795	3.125
13:33	1.113	18.902	3.093
13:34	0.958	19.037	3.143
13:35	1.099	18.927	3.125
13:36	1.082	18.940	3.126
13:37	1.281	18.800	3.072
13:38	1.424	18.640	3.089
13:39	1.333	18.771	3.033
13:40	1.312	18.780	3.047
13:41	1.243	18.837	3.065
13:42	1.098	18.879	3.068
13:43	0.944	19.036	3.082
13:44	1.197	18.878	3.094
13:45	1.272	18.735	3.123
13:46	1.258	18.750	3.112
13:47	1.390	18.685	3.030

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March 20, 2014
Start Time 13:07
Stop time 14:09

REFERENCE METHOD RUN 2

	Channel 1 O2	Channel 2 CO2	Channel 3 THC
	FCCU %dv	FCCU %dv	FCCU ppmwv
13:48	1.583	18.545	3.008
13:49	1.468	18.615	3.029
13:50	1.087	18.893	3.058
13:51	1.045	18.941	3.062
13:52	1.305	18.779	3.038
13:53	1.172	18.859	2.998
13:54	1.171	18.843	3.047
13:55	1.006	18.985	3.035
13:56	0.944	19.065	3.057
13:57	1.092	18.980	3.019
13:58	1.286	18.776	2.984
13:59	1.204	18.826	2.978
14:00	1.169	18.870	2.965
14:01	1.101	18.906	2.941
14:02	1.313	18.755	2.928
14:03	1.155	18.853	2.953
14:04	1.137	18.900	2.986
14:05	1.250	18.788	3.048
14:06	1.141	18.887	2.946
14:07	1.221	18.843	2.912
14:08	1.022	19.012	2.893
14:09	1.272	18.806	2.989

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Marathon
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March 20, 2014
Start Time 14:11
Stop Time 14:18

CALIBRATION BIAS 02

		Channel 1 O2	Channel 2 CO2	Channel 3 THC
		FCCU %dv	FCCU %dv	FCCU ppmwv
System Response to Calibration Gasses (C_S)				
C_{of}	Zero gas	0.009	0.082	0.050
C_{uf}	Upscale gas	4.492	19.028	25.865
Analyzer Calibration Error Reponses (C_{Dir})				
C_{oce}	Zero gas	0.001	0.043	0.026
C_{mce}	Upscale gas	4.545	19.082	24.602
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.1%	0.2%	0.0%
	Upscale gas	-0.6%	-0.3%	1.5%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	0.065	0.000	-0.114
C_{ui}	Upscale gas	4.560	18.994	24.692
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	-0.6%	0.4%	0.2%
	Upscale gas	-0.8%	0.2%	1.4%
Drift Assessment Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK

050514 174150

14:11:16	6.153	4.214	1.102
14:11:31	0.363	0.356	0.853
14:11:46	0.043	0.159	0.720
14:12:01	0.020	0.113	0.637
14:12:16	0.013	0.094	0.568
14:12:31	0.009	0.082	0.500
14:12:46	0.006	0.069	0.681
14:13:01	1.492	3.416	0.567
14:13:16	4.220	16.190	0.508
14:13:31	4.464	18.596	0.475
14:13:46	4.486	18.864	0.453
14:14:01	4.487	18.945	0.425
14:14:16	4.487	18.986	0.394
14:14:31	4.485	19.011	0.374
14:14:46	4.489	19.024	0.353
14:15:01	4.492	19.028	0.342
14:15:16	4.495	19.032	0.312
14:15:31	5.292	18.692	0.145
14:15:46	16.680	5.167	0.013
14:16:01	20.201	0.279	-0.116
14:16:16	20.847	0.189	0.073
14:16:31	20.913	0.147	0.052
14:16:46	20.922	0.117	0.026
14:17:01	20.859	0.128	20.316
14:17:16	20.598	0.169	25.698
14:17:31	20.578	0.011	25.804
14:17:46	20.644	0.069	25.877
14:18:01	20.648	0.059	25.915

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Stop Time 14:18

CALIBRATION BIAS 02

	Channel 1	Channel 2	Channel 3
	O2	CO2	THC
	FCCU	FCCU	FCCU
	%dv	%dv	ppmwv
14:18:16	20.649	0.050	25.762

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Start Time 14:20
Stop time 15:22

REFERENCE METHOD RUN 3

		Channel 1 O2 FCCU %dv	Channel 2 CO2 FCCU %dv	Channel 3 THC FCCU ppmwv
Calibration Checks				
C_{oi}	Initial zero	0.009	0.082	0.050
C_{ui}	Initial upscale	4.492	19.028	25.865
C_{of}	Final zero	0.010	0.083	0.179
C_{uf}	Final upscale	4.492	18.992	24.131
C_{ma}	Actual gas value	4.540	19.000	24.700
Analyzer Averages (concentrations)				
C_{Avg}	Average conc.	1.126	18.882	2.771
C_{Gas}	**Bias adjusted**	**1.131**	**18.871**	**2.637**

Clock Time (at end of sample period)			
050514 174150			
14:21	1.280	18.705	3.003
14:22	1.162	18.816	2.945
14:23	1.227	18.803	2.909
14:24	1.063	18.909	2.861
14:25	0.927	19.027	2.858
14:26	0.928	19.100	2.814
14:27	1.077	18.956	2.825
14:28	1.064	18.934	2.804
14:29	1.301	18.752	2.829
14:30	1.301	18.746	2.733
14:31	1.221	18.814	2.763
14:32	1.241	18.810	2.772
14:33	1.222	18.828	2.821
14:34	1.218	18.840	2.849
14:35	1.097	18.921	2.794
14:36	1.214	18.841	2.777
14:37	1.090	18.912	2.776
14:38	1.016	18.980	2.799
14:39	1.060	18.978	2.800
14:40	1.100	18.905	2.810
14:41	0.904	19.102	2.759
14:42	1.006	19.046	2.763
14:43	0.819	19.210	2.729
14:44	1.127	18.932	2.793
14:45	1.357	18.713	2.751
14:46	1.509	18.524	2.766
14:47	1.104	18.860	2.779
14:48	1.229	18.822	2.793
14:49	1.055	18.934	2.788
14:50	1.054	18.920	2.801
14:51	1.114	18.917	2.820
14:52	1.133	18.892	2.803
14:53	1.157	18.879	2.779
14:54	1.102	18.885	2.808
14:55	1.178	18.849	2.789
14:56	1.078	18.870	2.789
14:57	0.950	19.015	2.809
14:58	0.757	19.194	2.842
14:59	1.120	18.947	2.698
15:00	1.251	18.790	2.638

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March 20, 2014
Start Time 14:20
Stop time 15:22

REFERENCE METHOD RUN 3

	Channel 1 O2 FCCU %dv	Channel 2 CO2 FCCU %dv	Channel 3 THC FCCU ppmwv
15:01	1.204	18.794	2.619
15:02	1.150	18.821	2.712
15:03	1.021	18.957	2.753
15:04	1.170	18.839	2.812
15:05	1.323	18.721	2.766
15:06	1.346	18.493	2.694
15:07	1.344	18.713	2.771
15:08	0.986	18.955	2.834
15:09	1.022	18.968	2.839
15:10	1.142	18.862	2.756
15:11	1.163	18.790	2.768
15:12	1.007	18.998	2.744
15:13	1.253	18.786	2.687
15:14	1.433	18.633	2.693
15:15	1.215	18.781	2.715
15:16	0.957	18.996	2.706
15:17	1.001	18.965	2.745
15:18	1.025	18.958	2.670
15:19	1.060	18.900	2.612
15:20	1.016	18.998	2.617
15:21	1.053	18.956	2.594
15:22	1.134	18.906	2.655

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Marathon
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Garyville, LA
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March 20, 2014
Start Time 15:23
Stop Time 15:35

CALIBRATION BIAS 03

		Channel 1 O2	Channel 2 CO2	Channel 3 THC
		FCCU %dv	FCCU %dv	FCCU ppmwv
System Response to Calibration Gasses (C_S)				
C_{of}	Zero gas	0.010	0.083	0.179
C_{uf}	Upscale gas	4.492	18.992	24.131
Analyzer Calibration Error Reponses (C_{Dir})				
C_{oce}	Zero gas	0.001	0.043	0.026
C_{mce}	Upscale gas	4.545	19.082	24.602
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.1%	0.2%	0.2%
	Upscale gas	-0.6%	-0.5%	-0.6%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	0.009	0.082	0.050
C_{ui}	Upscale gas	4.492	19.028	25.865
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	0.0%	0.0%	0.2%
	Upscale gas	0.0%	-0.2%	-2.0%
Drift Assessment Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK

050514 174150

15:23:31	1.370	18.804	9.586
15:23:46	9.083	8.419	1.804
15:24:01	4.345	3.680	1.092
15:24:16	-5.054	-3.246	0.721
15:24:31	0.025	0.120	1.094
15:24:46	0.014	0.095	0.987
15:25:01	0.009	0.083	0.915
15:25:16	0.006	0.070	0.910
15:25:31	0.970	1.881	1.123
15:25:46	0.081	15.556	0.951
15:26:01	4.452	18.606	0.860
15:26:16	4.471	18.852	0.793
15:26:31	4.481	18.921	0.741
15:26:46	4.484	18.951	0.690
15:27:01	4.486	18.977	0.651
15:27:16	4.489	18.992	0.641
15:27:31	4.500	19.007	0.808
15:27:46	12.901	11.475	1.024
15:28:01	20.167	1.171	1.003
15:28:16	20.681	0.262	1.044
15:28:31	20.734	0.193	1.045
15:28:46	20.753	0.145	1.042
15:29:01	20.769	0.127	1.047
15:29:16	20.782	0.112	1.070
15:29:31	17.466	3.225	18.470
15:29:46	19.333	2.198	20.182
15:30:01	20.534	0.202	20.373
15:30:16	20.598	0.089	20.431

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU

March 20, 2014
Start Time 15:23
Stop Time 15:35

CALIBRATION BIAS 03

	Channel 1 O2 FCCU %dv	Channel 2 CO2 FCCU %dv	Channel 3 THC FCCU ppmwv
15:30:31	20.612	0.070	20.729
15:30:46	20.619	0.057	20.821
15:31:01	20.627	0.049	21.001
15:31:16	20.630	0.049	21.091
15:31:31	20.632	0.041	21.198
15:31:46	20.633	0.037	21.670
15:32:01	20.633	0.037	21.390
15:32:16	20.635	0.031	21.444
15:32:31	20.636	0.031	21.416
15:32:46	20.639	0.031	21.566
15:33:01	20.639	0.025	7.990
15:33:16	20.787	0.040	0.265
15:33:31	20.942	0.025	0.205
15:33:46	20.955	0.017	0.176
15:34:01	20.971	0.018	0.156
15:34:16	20.945	0.017	17.945
15:34:31	20.702	0.018	21.768
15:34:46	20.651	0.018	24.310
15:35:01	20.648	0.014	24.034
15:35:16	20.649	0.013	24.049

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

	March 21, 2014
Start Time	7:41
Stop Time	8:22

CALIBRATION ERROR

	Channel 1	Channel 2	Channel 3
	O2 FCCU Regenerato %dv	CO2 FCCU Regenerato %dv	THC FCCU Regenerato ppmwv
Instrument Information			
Manufacturer:	Servomex	Servomex	JUM
Model:	1420C	1415C	Heaated
Detection:	Paramagn.	NDIR	FID 3-500
Asset or Serial No:	207363	207493	208483
Calibration Span Value (CS)	9.050	19.000	85.600
System Response Time (seconds)			
Manufacturer Certified Cylinder Value (C_v)			
Zero	0.000	0.000	0.000
Low	4.540	9.140	24.700
Mid			45.400
High	9.050	19.000	85.600
Actual gas to be used for bias checks	4.540	19.000	24.700
Cylinder ID			
Zero	0114	0114	ALM054299
Low	0710	ALM23687	0810
Mid			AL1816
High	ALM23687	0710	ALM010763
Analyzer Calibration Response (C_{Dir})			
Zero	0.004	-0.006	-0.007
Low	4.535	8.797	24.746
Mid	N/A	N/A	45.414
High	9.021	19.112	85.563
Analyzer Calibration Error (ACE) (Limit = 2%, Method 25A limit = 5% of gas val			
Zero	0.0%	0.0%	0.0%
Low	-0.1%	-1.8%	0.2%
Mid	N/A	N/A	0.0%
High	-0.3%	0.6%	0.0%
Calibration Error Status			
Zero	OK	OK	OK
Low	OK	OK	OK
Mid	N/A	N/A	OK
High	OK	OK	OK

[redacted] 050514 175116

07:41:32	20.851	0.038	10.175
07:41:47	20.839	0.039	9.900
07:42:02	12.857	0.058	9.708
07:42:17	0.756	0.004	9.747
07:42:32	0.080	-0.004	9.698
07:42:47	0.034	-0.006	9.682
07:43:02	0.018	-0.004	9.604
07:43:17	0.010	-0.006	9.613
07:43:32	0.004	-0.006	9.963
07:43:47	-0.002	-0.005	10.619
07:44:02	1.080	0.042	10.769

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 7:41
Stop Time 8:22

CALIBRATION ERROR

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
07:44:17	7.852	3.000	10.952
07:44:32	8.934	7.865	10.989
07:44:47	8.978	8.822	10.984
07:45:02	8.937	8.850	10.698
07:45:17	9.013	8.853	11.031
07:45:32	9.011	8.845	10.934
07:45:47	9.014	8.843	10.940
07:46:02	9.020	8.817	10.977
07:46:17	9.021	8.797	11.451
07:46:32	9.021	8.797	11.375
07:46:47	9.021	8.797	11.437
07:47:02	9.011	8.797	11.320
07:47:17	5.170	12.815	11.289
07:47:32	4.257	15.723	11.320
07:47:47	4.381	15.828	11.432
07:48:02	4.427	16.023	11.083
07:48:17	4.383	16.312	1.833
07:48:32	4.412	16.710	9.338
07:48:47	4.435	17.300	74.129
07:49:02	4.451	17.631	45.931
07:49:17	4.481	18.091	51.860
07:49:32	4.501	18.462	26.724
07:49:47	4.511	18.652	8.589
07:50:02	4.519	18.785	52.433
07:50:17	4.522	18.822	8.195
07:50:32	4.527	18.884	9.849
07:50:47	4.532	18.940	10.216
07:51:02	4.531	18.999	10.152
07:51:17	4.533	19.018	10.173
07:51:32	4.535	19.033	18.024
07:51:47	4.538	19.070	62.686
07:52:02	4.533	19.093	8.840
07:52:17	4.534	19.104	8.738
07:52:32	4.535	19.113	9.867
07:52:47	4.536	19.117	10.512
08:02:29	20.863	0.045	-3.497
08:02:44	20.863	0.044	-0.780
08:02:59	20.777	0.062	11.108
08:03:14	10.867	0.515	-4.547
08:03:29	1.221	0.121	-4.648
08:03:44	0.240	0.016	-4.676
08:03:59	0.131	0.005	-4.697
08:04:14	0.104	0.000	-4.699
08:04:29	0.085	0.000	-4.707
08:04:44	0.075	-0.002	-4.523
08:04:59	3.212	0.001	-3.259
08:05:14	17.415	0.031	-3.367
08:05:29	20.468	0.039	-3.402
08:05:44	20.748	0.045	-3.440
08:05:59	20.796	0.044	-3.456
08:06:14	20.815	0.043	-3.505
08:06:29	19.606	0.129	-3.495
08:06:44	18.816	0.715	-3.446
08:06:59	20.627	0.132	-2.611

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 7:41
Stop Time 8:22

CALIBRATION ERROR

	Channel 1	Channel 2	Channel 3
	O2	CO2	THC
	FCCU	FCCU	FCCU
	Regenerato	Regenerato	Regenerato
	%dv	%dv	ppmwv
08:07:14	16.029	3.574	-2.846
08:07:29	6.892	15.166	-0.768
08:07:44	5.862	16.738	-4.518
08:07:59	4.709	18.535	-4.521
08:08:14	4.609	18.805	-4.520
08:08:29	4.602	18.822	-4.521
08:08:44	4.594	18.845	-4.523
08:08:59	4.583	18.876	-4.523
08:09:14	4.573	18.894	-4.521
08:09:29	4.563	18.907	-4.521
08:09:44	4.552	18.919	-4.510
08:09:59	4.553	18.924	-4.514
08:10:14	4.546	18.932	-4.511
08:10:29	4.544	18.938	-4.505
08:10:44	4.546	18.940	-4.617
08:10:59	10.814	13.052	-4.747
08:11:14	19.249	2.038	-4.781
08:11:29	20.719	0.374	-4.549
08:11:44	20.889	0.200	-0.426
08:11:59	20.925	0.139	0.073
08:12:14	20.949	0.111	0.080
08:12:29	20.959	0.090	0.080
08:12:44	20.972	0.079	0.083
08:12:59	20.977	0.066	29.649
08:13:14	20.647	0.153	84.111
08:13:29	20.640	0.100	84.399
08:13:44	20.693	0.049	84.832
08:13:59	20.698	0.043	85.615
08:14:14	20.698	0.032	85.605
08:14:29	20.703	0.031	85.490
08:14:44	20.705	0.029	85.607
08:14:59	20.708	0.024	85.594
08:15:14	20.711	0.024	85.564
08:15:29	20.713	0.020	18.063
08:15:44	20.875	0.039	0.443
08:15:59	20.992	0.020	0.103
08:16:14	21.005	0.016	0.019
08:16:29	21.006	0.013	-0.024
08:16:44	21.007	0.016	-0.016
08:16:59	21.008	0.011	3.370
08:17:14	20.766	0.042	24.444
08:17:29	20.572	0.051	24.702
08:17:44	20.666	0.008	24.739
08:17:59	20.623	-0.003	24.702
08:18:14	20.635	0.004	24.763
08:18:29	20.380	0.002	24.739
08:18:44	20.686	0.008	24.734
08:18:59	20.689	0.007	24.747
08:19:14	20.656	0.006	42.746
08:19:29	20.343	0.006	45.270
08:19:44	20.276	0.005	45.407
08:19:59	20.270	0.006	45.345
08:20:14	20.271	0.005	45.368
08:20:29	20.270	0.003	45.403

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 7:41
Stop Time 8:22

CALIBRATION ERROR

	Channel 1	Channel 2	Channel 3
	O2	CO2	THC
	FCCU	FCCU	FCCU
	Regenerato	Regenerato	Regenerato
	%dv	%dv	ppmwv
08:20:44	20.272	0.006	45.438
08:20:59	20.270	0.003	45.275
08:21:14	20.270	0.002	45.309
08:21:29	20.273	0.005	45.429
08:21:44	20.273	0.002	45.468
08:21:59	20.271	0.002	45.343
08:22:14	20.271	0.004	45.449
08:22:29	20.270	0.000	45.006
08:22:44	20.306	0.003	4.238
08:22:59	20.623	0.030	1.677

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 8:02
Stop Time 8:22

CALIBRATION BIAS 00

		Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
System Response to Calibration Gasses (C_S)				
C_{of}	Zero gas	0.088	0.000	-0.007
C_{uf}	Upscale gas	4.548	18.931	24.746
Analyzer Calibration Error Reponses (C_{Dir})				
C_{oce}	Zero gas	0.004	-0.006	-0.007
C_{mce}	Upscale gas	4.535	19.112	24.746
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.9%	0.0%	0.0%
	Upscale gas	0.1%	-0.9%	0.0%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	N/A	N/A	N/A
C_{ui}	Upscale gas	N/A	N/A	N/A
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	N/A	N/A	N/A
	Upscale gas	N/A	N/A	N/A
Drift Assessment Status				
	Zero gas	N/A	N/A	N/A
	Upscale gas	N/A	N/A	N/A

050514 175116

08:02:29	20.863	0.045	-3.497
08:02:44	20.863	0.044	-0.780
08:02:59	20.777	0.062	11.108
08:03:14	10.867	0.515	-4.547
08:03:29	1.221	0.121	-4.648
08:03:44	0.240	0.016	-4.676
08:03:59	0.131	0.005	-4.697
08:04:14	0.104	0.000	-4.699
08:04:29	0.085	0.000	-4.707
08:04:44	0.075	-0.002	-4.523
08:04:59	3.212	0.001	-3.259
08:05:14	17.415	0.031	-3.367
08:05:29	20.468	0.039	-3.402
08:05:44	20.748	0.045	-3.440
08:05:59	20.796	0.044	-3.456
08:06:14	20.815	0.043	-3.505
08:06:29	19.606	0.129	-3.495
08:06:44	18.816	0.715	-3.446
08:06:59	20.627	0.132	-2.611
08:07:14	16.029	3.574	-2.846
08:07:29	6.892	15.166	-0.768
08:07:44	5.862	16.738	-4.518
08:07:59	4.709	18.535	-4.521
08:08:14	4.609	18.805	-4.520
08:08:29	4.602	18.822	-4.521
08:08:44	4.594	18.845	-4.523
08:08:59	4.583	18.876	-4.523
08:09:14	4.573	18.894	-4.521

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 8:02
Stop Time 8:22

CALIBRATION BIAS 00

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
08:09:29	4.563	18.907	-4.521
08:09:44	4.552	18.919	-4.510
08:09:59	4.553	18.924	-4.514
08:10:14	4.546	18.932	-4.511
08:10:29	4.544	18.938	-4.505
08:10:44	4.546	18.940	-4.617
08:10:59	10.814	13.052	-4.747
08:11:14	19.249	2.038	-4.781
08:11:29	20.719	0.374	-4.549
08:11:44	20.889	0.200	-0.426
08:11:59	20.925	0.139	0.073
08:12:14	20.949	0.111	0.080
08:12:29	20.959	0.090	0.080
08:12:44	20.972	0.079	0.083
08:12:59	20.977	0.066	29.649
08:13:14	20.647	0.153	84.111
08:13:29	20.640	0.100	84.399
08:13:44	20.693	0.049	84.832
08:13:59	20.698	0.043	85.615
08:14:14	20.698	0.032	85.605
08:14:29	20.703	0.031	85.490
08:14:44	20.705	0.029	85.607
08:14:59	20.708	0.024	85.594
08:15:14	20.711	0.024	85.564
08:15:29	20.713	0.020	18.063
08:15:44	20.875	0.039	0.443
08:15:59	20.992	0.020	0.103
08:16:14	21.005	0.016	0.019
08:16:29	21.006	0.013	-0.024
08:16:44	21.007	0.016	-0.016
08:16:59	21.008	0.011	3.370
08:17:14	20.766	0.042	24.444
08:17:29	20.572	0.051	24.702
08:17:44	20.666	0.008	24.739
08:17:59	20.623	-0.003	24.702
08:18:14	20.635	0.004	24.763
08:18:29	20.380	0.002	24.739
08:18:44	20.686	0.008	24.734
08:18:59	20.689	0.007	24.747
08:19:14	20.656	0.006	42.746
08:19:29	20.343	0.006	45.270
08:19:44	20.276	0.005	45.407
08:19:59	20.270	0.006	45.345
08:20:14	20.271	0.005	45.368
08:20:29	20.270	0.003	45.403
08:20:44	20.272	0.006	45.438
08:20:59	20.270	0.003	45.275
08:21:14	20.270	0.002	45.309
08:21:29	20.273	0.005	45.429
08:21:44	20.273	0.002	45.468
08:21:59	20.271	0.002	45.343
08:22:14	20.271	0.004	45.449
08:22:29	20.270	0.000	45.006
08:22:44	20.306	0.003	4.238
08:22:59	20.623	0.030	1.677

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 8:34
Stop time 9:54

REFERENCE METHOD RUN 4

		Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv	Channel 4
Calibration Checks					
C_{oi}	Initial zero	0.088	0.000	-0.007	
C_{ui}	Initial upscale	4.548	18.931	24.746	
C_{of}	Final zero	0.083	0.017	0.248	
C_{uf}	Final upscale	4.514	18.935	23.146	
C_{ma}	Actual gas value	4.540	19.000	24.700	
Analyzer Averages (concentrations)					
C_{Avg}	Average conc.	3.273	16.790	2.522	
C_{Gas}	**Bias adjusted**	**3.255**	**16.848**	**2.490**	

Clock Time (at end of sample period)				
050514 175116				
08:35	20.861	0.047	1.455	
08:36	20.863	0.047	1.403	
08:37	20.863	0.046	1.369	
08:38	20.861	0.048	1.678	
08:39	20.837	0.047	1.618	
08:40	20.859	0.048	1.543	
08:41	20.859	0.046	1.809	
08:42	18.645	1.675	1.898	
08:43	1.493	18.238	2.417	
08:44	1.180	18.771	2.436	start run 4
08:45	1.353	18.610	2.707	
08:46	1.277	18.629	2.794	
08:47	1.400	18.603	2.876	
08:48	1.379	18.556	2.943	
08:49	1.237	18.709	2.889	
08:50	1.146	18.797	2.881	
08:51	1.224	18.757	2.953	
08:52	1.182	18.759	2.895	
08:53	1.075	18.821	2.893	
08:54	1.206	18.770	2.891	
08:55	1.384	18.605	2.849	
08:56	1.390	18.591	2.802	
08:57	1.533	18.490	2.789	
08:58	1.337	18.571	2.785	
08:59	1.187	18.758	2.827	
09:00	1.384	18.585	2.836	
09:01	1.651	18.401	2.797	
09:02	1.668	18.359	2.772	
09:03	1.435	18.513	2.802	
09:04	1.388	18.571	2.811	
09:05	1.233	18.688	2.793	
09:06	1.186	18.763	2.753	
09:07	1.090	18.855	2.692	
09:08	1.185	18.792	2.708	
09:09	1.334	18.650	2.715	
09:10	1.272	18.689	2.735	
09:11	1.441	18.543	2.775	
09:12	2.933	17.574	2.552	move ports
09:13	3.995	15.695	2.708	move ports
09:14	1.437	18.526	2.750	move ports

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 8:34
Stop time 9:54

REFERENCE METHOD RUN 4

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv	Channel 4
09:15	1.376	18.574	2.744	
09:16	1.241	18.744	2.757	
09:17	1.214	18.768	2.704	
09:18	1.090	18.840	2.705	
09:19	1.138	18.835	2.730	
09:20	1.387	18.584	2.903	
09:21	1.250	18.759	2.637	
09:22	1.406	18.589	2.681	
09:23	1.203	18.771	2.588	
09:24	1.169	18.805	2.621	
09:25	1.165	18.817	2.592	
09:26	1.158	18.841	2.602	
09:27	1.425	18.589	2.649	
09:28	1.207	18.777	2.575	
09:29	1.132	18.842	2.592	
09:30	1.186	18.800	2.607	
09:31	1.333	18.711	2.518	
09:32	1.374	18.649	2.541	
09:33	1.293	18.656	2.590	
09:34	1.247	18.747	2.561	
09:35	1.164	18.805	2.605	
09:36	1.139	18.827	2.540	
09:37	1.065	18.898	2.481	
09:38	0.989	18.943	2.462	
09:39	0.995	18.993	2.435	
09:40	1.145	18.882	2.444	
09:41	1.312	18.732	2.404	
09:42	1.215	18.774	2.428	
09:43	1.239	18.759	2.453	
09:44	1.156	18.806	2.491	
09:45	1.041	18.921	2.518	
09:46	1.146	18.847	2.484	
09:47	1.363	18.707	2.399	
09:48	1.432	18.592	2.681	
09:49	1.251	18.709	2.213	
09:50	1.366	18.651	2.109	
09:51	1.292	18.678	2.108	
09:52	1.361	18.624	2.137	
09:53	1.179	18.783	2.156	
09:54	1.271	18.736	2.184	

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 9:56
Stop Time 10:05

CALIBRATION BIAS 01

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
System Response to Calibration Gasses (C_S)			
C_{of} Zero gas	0.083	0.017	0.248
C_{uf} Upscale gas	4.514	18.935	23.146
Analyzer Calibration Error Reponses (C_{Dir})			
C_{oce} Zero gas	0.004	-0.006	-0.007
C_{mce} Upscale gas	4.535	19.112	24.746
Actual Upscale Gas Value (C_{MA})			
C_{ma} Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)			
	9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)			
Zero gas	0.9%	0.1%	0.3%
Upscale gas	-0.2%	-0.9%	-1.9%
System Bias Status			
Zero gas	OK	OK	OK
Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)			
C_{oi} Zero gas	0.088	0.000	-0.007
C_{ui} Upscale gas	4.548	18.931	24.746
Drift Assessment as Percent of Calibration Span Value (D) (3%)			
Zero gas	0.0%	0.1%	0.3%
Upscale gas	-0.4%	0.0%	-1.9%
Drift Assessment Status			
Zero gas	OK	OK	OK
Upscale gas	OK	OK	OK

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09:56:03	20.746	0.189	16.674
09:56:18	17.074	0.297	15.212
09:56:33	15.912	0.177	18.331
09:56:48	20.287	0.085	18.654
09:57:03	20.605	0.076	19.341
09:57:18	20.633	0.069	22.004
09:57:33	20.643	0.060	22.533
09:57:48	20.648	0.059	22.743
09:58:03	20.589	0.026	22.766
09:58:18	20.658	0.048	22.787
09:58:33	20.664	0.049	23.331
09:58:48	20.666	0.042	23.321
09:59:03	20.670	0.042	5.027
09:59:18	20.709	0.001	0.210
09:59:33	20.939	0.033	0.361
09:59:48	20.991	0.032	0.320
10:00:03	20.997	0.031	0.298
10:00:18	20.998	0.027	0.265
10:00:33	21.000	0.030	0.248
10:00:48	21.003	0.025	0.231
10:01:03	20.995	0.022	0.304
10:01:18	12.838	0.024	0.261
10:01:33	1.672	0.018	0.272
10:01:48	0.289	0.020	0.272
10:02:03	0.160	0.018	0.261
10:02:18	0.121	0.018	0.256
10:02:33	0.100	0.018	0.256
10:02:48	0.081	0.018	0.252

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 9:56
Stop Time 10:05

CALIBRATION BIAS 01

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
10:03:03	0.069	0.016	0.427
10:03:18	0.404	0.472	0.505
10:03:33	3.390	11.410	0.443
10:03:48	4.420	17.820	0.425
10:04:03	4.516	18.647	0.420
10:04:18	4.524	18.804	0.414
10:04:33	4.519	18.862	0.399
10:04:48	4.516	18.912	0.392
10:05:03	4.514	18.940	0.383
10:05:18	4.512	18.952	0.386

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 7:41
Stop Time 8:22

CALIBRATION ERROR 02

	Channel 1	Channel 2	Channel 3
	O2 FCCU Regenerato	CO2 FCCU Regenerato	THC FCCU Regenerato
	%dv	%dv	ppmwv
Instrument Information			
Manufacturer:	Servomex	Servomex	JUM
Model:	1420C	1415C	Heaated
Detection:	Paramagn.	NDIR	FID 3-500
Asset or Serial No:	207363	207493	208483
Calibration Span Value (CS)	9.050	19.000	85.600
System Response Time (seconds)			
Manufacturer Certified Cylinder Value (C_V)			
Zero	0.000	0.000	0.000
Low	4.540	9.140	24.700
Mid			45.400
High	9.050	19.000	85.600
Actual gas to be used for bias checks	4.540	19.000	24.700
Cylinder ID			
Zero	0114	0114	ALM054299
Low	0710	ALM23687	0810
Mid			AL1816
High	ALM23687	0710	ALM010763
Analyzer Calibration Response (C_{Dir})			
Zero	0.004	-0.006	0.159
Low	4.535	8.797	25.141
Mid	N/A	N/A	45.671
High	9.021	19.112	85.495
Analyzer Calibration Error (ACE) (Limit = 2%, Method 25A limit = 5% of gas val			
Zero	0.0%	0.0%	0.2%
Low	-0.1%	-1.8%	1.8%
Mid	NA	NA	0.6%
High	-0.3%	0.6%	-0.1%
Calibration Error Status			
Zero	OK	OK	OK
Low	OK	OK	OK
Mid	NA	NA	OK
High	OK	OK	OK

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10:17:06	20.718	0.009	89.276
10:17:21	20.719	0.007	86.089
10:17:36	20.720	0.006	86.274
10:17:51	20.719	0.009	87.012
10:18:06	20.718	0.006	87.118
10:18:21	20.719	0.007	87.243
10:18:36	20.719	0.007	58.548
10:18:51	20.765	0.043	0.925
10:19:06	20.973	0.021	0.537
10:19:21	21.011	0.008	0.420
10:19:36	21.012	0.006	0.361

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 7:41
Stop Time 8:22

CALIBRATION ERROR 02

	Channel 1	Channel 2	Channel 3
	O2 FCCU Regenerato	CO2 FCCU Regenerato	THC FCCU Regenerato
	%dv	%dv	ppmwv
10:19:51	21.011	0.006	0.314
10:20:06	21.013	0.006	0.272
10:20:21	21.012	0.006	0.252
10:20:36	21.014	0.006	3.865
10:20:51	20.914	0.020	25.768
10:21:06	20.706	0.014	25.661
10:21:21	20.692	0.006	25.664
10:21:36	20.692	0.006	31.321
10:21:51	20.696	0.006	87.515
10:22:06	20.719	0.006	85.439
10:22:21	20.722	0.006	85.687
10:22:36	20.724	0.004	86.133
10:22:51	20.727	0.006	85.415
10:23:06	20.724	0.005	85.180
10:23:21	20.725	0.005	85.509
10:23:36	20.723	0.006	85.794
10:23:51	20.724	0.005	80.829
10:24:06	20.700	0.006	26.042
10:24:21	20.688	0.006	25.338
10:24:36	20.693	0.005	25.284
10:24:51	20.692	0.006	25.192
10:25:06	20.693	0.005	25.184
10:25:21	20.694	0.005	25.047
10:25:36	20.691	0.006	26.234
10:25:51	20.599	0.005	45.338
10:26:06	20.301	0.005	45.704
10:26:21	20.273	0.006	45.661
10:26:36	20.270	0.005	45.649
10:26:51	20.271	0.006	36.158
10:27:06	20.437	-0.002	0.519
10:27:21	20.881	-0.003	0.249
10:27:36	21.006	0.004	0.200
10:27:51	21.016	0.003	0.185
10:28:06	21.018	0.003	0.153
10:28:21	21.019	0.006	0.137
10:28:36	21.018	0.001	0.871

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 10:17
Stop Time 10:28

Calibration Bias 01b

		Channel 1 O2	Channel 2 CO2	Channel 3 THC
		FCCU Regenerator %dv	Regenerator %dv	Regenerator ppmwv
System Response to Calibration Gasses (C_S)				
C_{of}	Zero gas	0.083	0.017	0.159
C_{uf}	Upscale gas	4.514	18.935	25.141
Analyzer Calibration Error Reponses (C_{Dir})				
C_{oce}	Zero gas	0.004	-0.006	0.159
C_{mce}	Upscale gas	4.535	19.112	25.141
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.9%	0.1%	0.0%
	Upscale gas	-0.2%	-0.9%	0.0%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	N/A	N/A	N/A
C_{ui}	Upscale gas	N/A	N/A	N/A
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	N/A	N/A	N/A
	Upscale gas	N/A	N/A	N/A
Drift Assessment Status				
	Zero gas	N/A	N/A	N/A
	Upscale gas	N/A	N/A	N/A

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10:17:06	20.718	0.009	89.276
10:17:21	20.719	0.007	86.089
10:17:36	20.720	0.006	86.274
10:17:51	20.719	0.009	87.012
10:18:06	20.718	0.006	87.118
10:18:21	20.719	0.007	87.243
10:18:36	20.719	0.007	58.548
10:18:51	20.765	0.043	0.925
10:19:06	20.973	0.021	0.537
10:19:21	21.011	0.008	0.420
10:19:36	21.012	0.006	0.361
10:19:51	21.011	0.006	0.314
10:20:06	21.013	0.006	0.272
10:20:21	21.012	0.006	0.252
10:20:36	21.014	0.006	3.865
10:20:51	20.914	0.020	25.768
10:21:06	20.706	0.014	25.661
10:21:21	20.692	0.006	25.664
10:21:36	20.692	0.006	31.321
10:21:51	20.696	0.006	87.515
10:22:06	20.719	0.006	85.439
10:22:21	20.722	0.006	85.687
10:22:36	20.724	0.004	86.133
10:22:51	20.727	0.006	85.415
10:23:06	20.724	0.005	85.180
10:23:21	20.725	0.005	85.509
10:23:36	20.723	0.006	85.794
10:23:51	20.724	0.005	80.829

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 10:17
Stop Time 10:28

Calibration Bias 01b

	Channel 1 O2	Channel 2 CO2	Channel 3 THC
	FCCU Regenerator %dv	Regenerator %dv	Regenerator ppmwv
10:24:06	20.700	0.006	26.042
10:24:21	20.688	0.006	25.338
10:24:36	20.693	0.005	25.284
10:24:51	20.692	0.006	25.192
10:25:06	20.693	0.005	25.184
10:25:21	20.694	0.005	25.047
10:25:36	20.691	0.006	26.234
10:25:51	20.599	0.005	45.338
10:26:06	20.301	0.005	45.704
10:26:21	20.273	0.006	45.661
10:26:36	20.270	0.005	45.649
10:26:51	20.271	0.006	36.158
10:27:06	20.437	-0.002	0.519
10:27:21	20.881	-0.003	0.249
10:27:36	21.006	0.004	0.200
10:27:51	21.016	0.003	0.185
10:28:06	21.018	0.003	0.153
10:28:21	21.019	0.006	0.137
10:28:36	21.018	0.001	0.871

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 10:30
Stop time 11:40

REFERENCE METHOD RUN 5

		Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv	Channel 4
Calibration Checks					
C_{oi}	Initial zero	0.083	0.017	0.159	
C_{ui}	Initial upscale	4.514	18.935	25.141	
C_{of}	Final zero	0.083	0.017	-1.390	
C_{uf}	Final upscale	4.514	18.935	13.026	
C_{ma}	Actual gas value	4.540	19.000	24.700	
Analyzer Averages (concentrations)					
C_{Avg}	Average conc.	1.163	18.846	1.329	
C_{Gas}	**Bias adjusted**	**1.107**	**18.911**	**2.438**	

Clock Time (at end of sample period) 050514 175116				
10:31	1.239	18.775	2.712	
10:32	1.335	18.693	2.687	
10:33	1.337	18.654	2.687	
10:34	1.278	18.723	2.590	
10:35	1.042	18.896	2.592	
10:36	0.853	19.092	2.585	
10:37	0.987	18.992	2.583	
10:38	1.061	18.930	2.549	
10:39	1.270	18.779	2.530	
10:40	1.166	18.861	2.448	
10:41	1.114	18.908	2.425	
10:42	1.020	19.015	2.375	
10:43	0.941	19.064	2.372	
10:44	0.933	19.069	2.379	
10:45	0.989	19.016	2.280	
10:46	0.953	19.065	2.182	
10:47	0.948	19.051	2.209	
10:48	0.828	19.153	2.176	
10:49	0.811	19.162	2.156	
10:50	0.910	19.117	2.092	
10:51	1.198	18.877	2.075	
10:52	1.164	18.834	1.896	
10:53	11.681	9.486	1.360	moving CEMs probe
10:54	20.759	0.183	0.918	
10:55	20.811	0.116	0.944	
10:56	15.994	4.135	1.141	
10:57	1.359	18.646	1.830	
10:58	1.347	18.692	1.921	CEM probe back in duct
10:59	1.193	18.802	1.958	
11:00	1.307	18.682	1.929	
11:01	1.165	18.844	1.924	
11:02	1.191	18.838	1.939	
11:03	1.111	18.929	1.898	
11:04	1.078	18.942	1.840	
11:05	1.292	18.756	1.823	
11:06	1.401	18.643	1.813	
11:07	1.185	18.806	1.830	
11:08	1.139	18.877	1.792	
11:09	1.093	18.914	1.760	
11:10	1.119	18.906	1.726	

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 10:30
Stop time 11:40

REFERENCE METHOD RUN 5

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv	Channel 4
11:11	1.382	18.673	1.729	
11:12	1.271	18.783	1.694	
11:13	1.374	18.676	1.724	
11:14	1.233	18.802	1.737	
11:15	1.283	18.746	1.698	
11:16	1.269	18.768	1.676	
11:17	1.432	18.634	1.695	
11:18	1.339	18.662	1.574	
11:19	1.256	18.735	1.529	
11:20	1.263	18.747	1.538	
11:21	1.221	18.819	1.464	
11:22	1.116	18.843	1.451	
11:23	1.074	18.902	1.405	
11:24	1.246	18.809	1.385	
11:25	1.423	18.589	1.356	
11:26	1.406	18.594	1.327	
11:27	1.309	18.703	1.207	
11:28	1.345	18.703	-0.328	
11:29	1.246	18.724	-1.272	
11:30	1.151	18.847	-1.296	
11:31	1.171	18.843	-1.319	
11:32	1.107	18.926	-1.335	
11:33	1.234	18.755	-1.350	
11:34	1.126	18.860	-1.363	
11:35	1.223	18.763	-1.366	
11:36	0.997	18.964	-1.369	
11:37	0.974	18.937	-1.394	
11:38	1.032	18.954	-1.380	
11:39	1.026	18.966	-1.382	
11:40	1.090	18.904	-1.381	

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 11:43
Stop Time 11:50

CALIBRATION BIAS 02

		Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
System Response to Calibration Gasses (C_S)				
C_{of}	Zero gas	0.083	0.017	-1.390
C_{uf}	Upscale gas	4.514	18.935	13.026
Analyzer Calibration Error Reponses (C_{Dir})				
C_{oce}	Zero gas	0.004	-0.006	0.159
C_{mce}	Upscale gas	4.535	19.112	25.141
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.9%	0.1%	-1.8%
	Upscale gas	-0.2%	-0.9%	-14.2%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	FAIL
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	0.083	0.017	0.159
C_{ui}	Upscale gas	4.514	18.935	25.141
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	0.0%	0.0%	-1.8%
	Upscale gas	0.0%	0.0%	-14.2%
Drift Assessment Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	FAIL

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11:43:07	1.243	18.779	-1.389
11:43:22	1.242	18.722	-1.392
11:43:37	1.180	18.799	-1.389
11:43:52	1.213	18.798	-1.389
11:44:07	3.282	17.302	-1.392
11:44:22	4.235	16.265	-1.397
11:44:37	4.246	16.248	-1.395
11:44:52	4.309	16.086	-1.386
11:45:07	4.983	13.645	11.911
11:45:22	2.947	13.299	26.178
11:45:37	2.451	13.382	16.469
11:45:52	2.155	13.369	13.278
11:46:07	2.356	13.378	12.179
11:46:22	2.356	13.374	12.418
11:46:37	2.358	13.375	12.321
11:46:52	2.355	13.376	12.638
11:47:07	2.311	13.987	12.848
11:47:22	2.030	16.979	12.661
11:47:37	1.984	17.505	13.298
11:47:52	1.984	17.478	12.874
11:48:07	1.985	17.442	13.065
11:48:22	1.987	17.423	13.079
11:48:37	1.985	17.405	13.600
11:48:52	2.039	17.484	13.424
11:49:07	2.141	17.589	13.026
11:49:22	2.149	17.642	13.558
11:49:37	2.145	17.624	13.547
11:49:52	15.458	7.347	13.747

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 11:43
Stop Time 11:50

CALIBRATION BIAS 02

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
11:50:07	20.479	0.283	13.659
11:50:22	20.638	0.063	13.700

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 7:41
Stop Time 8:22

CALIBRATION ERROR 03

	Channel 1	Channel 2	Channel 3
	O2 FCCU Regenerato %dv	CO2 FCCU Regenerato %dv	THC FCCU Regenerato ppmwv
Instrument Information			
Manufacturer:	Servomex	Servomex	JUM
Model:	1420C	1415C	Heaated
Detection:	Paramagn.	NDIR	FID 3-500
Asset or Serial No:	207363	207493	208483
Calibration Span Value (CS)			
	9.050	19.000	85.600
System Response Time (seconds)			
Manufacturer Certified Cylinder Value (C_V)			
Zero	0.000	0.000	0.000
Low	4.540	9.140	24.700
Mid			45.400
High	9.050	19.000	85.600
Actual gas to be used for bias checks			
	4.540	19.000	24.700
Cylinder ID			
Zero	0114	0114	ALM054299
Low	0710	ALM23687	0810
Mid			AL1816
High	ALM23687	0710	ALM010763
Analyzer Calibration Response (C_{Dir})			
Zero	0.004	-0.006	0.112
Low	4.535	8.797	24.945
Mid	N/A	N/A	47.372
High	9.021	19.112	85.704
Analyzer Calibration Error (ACE) (Limit = 2%, Method 25A limit = 5% of gas val			
Zero	0.0%	0.0%	0.1%
Low	-0.1%	-1.8%	1.0%
Mid	NA	NA	4.3%
High	-0.3%	0.6%	0.1%
Calibration Error Status			
Zero	OK	OK	OK
Low	OK	OK	OK
Mid	NA	NA	OK
High	OK	OK	OK

050514 175116

11:55:09	21.004	0.013	0.384
11:55:24	21.003	0.012	0.373
11:55:39	21.002	0.012	0.371
11:55:54	21.002	0.012	0.389
11:56:09	21.004	0.012	0.405
11:56:24	21.005	0.012	0.384
11:56:39	21.006	0.012	0.389
11:56:54	21.007	0.012	0.407
11:57:09	21.006	0.012	0.457
11:57:24	20.897	-0.008	0.432
11:57:39	20.838	-0.002	0.352

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 7:41
Stop Time 8:22

CALIBRATION ERROR 03

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
11:57:54	21.004	0.012	0.445
11:58:09	21.003	0.010	0.464
11:58:24	21.003	0.012	0.414
11:58:39	21.001	0.012	0.407
11:58:54	21.000	0.010	0.450
11:59:09	20.987	0.011	12.877
11:59:24	20.764	0.012	16.241
11:59:39	20.682	0.008	16.697
11:59:54	20.673	0.011	38.150
12:00:09	20.561	0.011	56.640
12:00:24	20.684	0.010	56.848
12:00:39	20.709	0.010	57.083
12:18:57	20.993	0.007	1.232
12:19:12	20.993	0.007	0.314
12:19:27	20.993	0.006	0.280
12:19:42	20.993	0.007	0.285
12:19:57	20.992	0.007	33.169
12:20:12	20.902	0.006	104.977
12:20:27	20.722	0.007	91.762
12:20:42	20.707	0.006	85.291
12:20:57	20.706	0.006	85.407
12:21:12	20.703	0.007	85.501
12:21:27	20.703	0.006	85.929
12:21:42	20.703	0.008	86.818
12:21:57	20.704	0.007	84.944
12:22:12	20.703	0.006	85.195
12:22:27	20.704	0.008	84.811
12:22:42	20.703	0.007	85.153
12:22:57	20.701	0.006	85.947
12:23:12	20.704	0.010	86.141
12:23:27	20.703	0.005	86.151
12:23:42	20.674	0.007	51.683
12:23:57	20.329	0.008	46.431
12:24:12	20.250	0.006	46.460
12:24:27	20.246	0.008	46.530
12:24:42	20.245	0.008	46.909
12:24:57	20.246	0.006	47.298
12:44:07	20.708	0.008	86.050
12:44:23	20.709	0.006	85.986
12:44:37	20.708	0.007	85.457
12:44:53	20.708	0.006	85.669
12:45:07	20.708	0.006	85.941
12:45:23	20.716	0.009	6.276
12:45:37	20.892	0.008	0.329
12:45:53	20.983	0.007	0.174
12:46:07	20.991	0.010	0.101
12:46:23	20.991	0.007	0.059
12:46:37	20.991	0.008	10.634
12:46:52	20.846	0.010	24.850
12:47:07	20.688	0.006	24.920
12:47:22	20.675	0.010	24.946
12:47:37	20.674	0.008	24.970
12:47:52	20.673	0.008	36.951
12:48:08	20.412	0.008	47.284

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 7:41
Stop Time 8:22

CALIBRATION ERROR 03

	Channel 1	Channel 2	Channel 3
	O2 FCCU Regenerato	CO2 FCCU Regenerato	THC FCCU Regenerato
	%dv	%dv	ppmwv
12:48:22	20.257	0.006	47.329
12:48:38	20.244	0.006	47.424
12:48:52	20.240	0.008	47.363
12:49:08	20.244	0.007	47.635
12:49:22	20.243	0.008	47.611
12:49:38	20.287	0.008	3.897

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 11:55
Stop Time 12:49

Calibration Bias 02b

		Channel 1 O2	Channel 2 CO2	Channel 3 THC
		FCCU Regenerator %dv	Regenerator %dv	Regenerator ppmwv
System Response to Calibration Gasses (C_S)				
C_{of}	Zero gas	0.083	0.017	0.112
C_{uf}	Upscale gas	4.514	18.935	24.945
Analyzer Calibration Error Reponses (C_{Dlr})				
C_{oce}	Zero gas	0.004	-0.006	0.112
C_{mce}	Upscale gas	4.535	19.112	24.945
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.9%	0.1%	0.0%
	Upscale gas	-0.2%	-0.9%	0.0%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	N/A	N/A	N/A
C_{ui}	Upscale gas	N/A	N/A	N/A
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	N/A	N/A	N/A
	Upscale gas	N/A	N/A	N/A
Drift Assessment Status				
	Zero gas	N/A	N/A	N/A
	Upscale gas	N/A	N/A	N/A

050514 175116			
11:55:09	21.004	0.013	0.384
11:55:24	21.003	0.012	0.373
11:55:39	21.002	0.012	0.371
11:55:54	21.002	0.012	0.389
11:56:09	21.004	0.012	0.405
11:56:24	21.005	0.012	0.384
11:56:39	21.006	0.012	0.389
11:56:54	21.007	0.012	0.407
11:57:09	21.006	0.012	0.457
11:57:24	20.897	-0.008	0.432
11:57:39	20.838	-0.002	0.352
11:57:54	21.004	0.012	0.445
11:58:09	21.003	0.010	0.464
11:58:24	21.003	0.012	0.414
11:58:39	21.001	0.012	0.407
11:58:54	21.000	0.010	0.450
11:59:09	20.987	0.011	12.877
11:59:24	20.764	0.012	16.241
11:59:39	20.682	0.008	16.697
11:59:54	20.673	0.011	38.150
12:00:09	20.561	0.011	56.640
12:00:24	20.684	0.010	56.848
12:00:39	20.709	0.010	57.083
12:18:57	20.993	0.007	1.232
12:19:12	20.993	0.007	0.314
12:19:27	20.993	0.006	0.280
12:19:42	20.993	0.007	0.285
12:19:57	20.992	0.007	33.169

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 11:55
Stop Time 12:49

Calibration Bias 02b

	Channel 1 O2	Channel 2 CO2	Channel 3 THC
	FCCU Regenerator %dv	Regenerator %dv	Regenerator ppmwv
12:20:12	20.902	0.006	104.977
12:20:27	20.722	0.007	91.762
12:20:42	20.707	0.006	85.291
12:20:57	20.706	0.006	85.407
12:21:12	20.703	0.007	85.501
12:21:27	20.703	0.006	85.929
12:21:42	20.703	0.008	86.818
12:21:57	20.704	0.007	84.944
12:22:12	20.703	0.006	85.195
12:22:27	20.704	0.008	84.811
12:22:42	20.703	0.007	85.153
12:22:57	20.701	0.006	85.947
12:23:12	20.704	0.010	86.141
12:23:27	20.703	0.005	86.151
12:23:42	20.674	0.007	51.683
12:23:57	20.329	0.008	46.431
12:24:12	20.250	0.006	46.460
12:24:27	20.246	0.008	46.530
12:24:42	20.245	0.008	46.909
12:24:57	20.246	0.006	47.298
12:44:07	20.708	0.008	86.050
12:44:23	20.709	0.006	85.986
12:44:37	20.708	0.007	85.457
12:44:53	20.708	0.006	85.669
12:45:07	20.708	0.006	85.941
12:45:23	20.716	0.009	6.276
12:45:37	20.892	0.008	0.329
12:45:53	20.983	0.007	0.174
12:46:07	20.991	0.010	0.101
12:46:23	20.991	0.007	0.059
12:46:37	20.991	0.008	10.634
12:46:52	20.846	0.010	24.850
12:47:07	20.688	0.006	24.920
12:47:22	20.675	0.010	24.946
12:47:37	20.674	0.008	24.970
12:47:52	20.673	0.008	36.951
12:48:08	20.412	0.008	47.284
12:48:22	20.257	0.006	47.329
12:48:38	20.244	0.006	47.424
12:48:52	20.240	0.008	47.363
12:49:08	20.244	0.007	47.635
12:49:22	20.243	0.008	47.611
12:49:38	20.287	0.008	3.897

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Marathon March 21, 2014
CleanAir Project No. 12461 Start Time 12:51
Garyville, LA Stop time 13:52
FCCU Regenerator **REFERENCE METHOD RUN 6**

		Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv	Channel 4
Calibration Checks					
C_{ci}	Initial zero	0.083	0.017	0.112	
C_{ui}	Initial upscale	4.514	18.935	24.945	
C_{cf}	Final zero	0.029	0.074	0.687	
C_{uf}	Final upscale	4.488	18.929	24.461	
C_{ma}	Actual gas value	4.540	19.000	24.700	
Analyzer Averages (concentrations)					
C_{Avg}	Average conc.	0.917	19.059	2.470	
C_{Gas}	**Bias adjusted**	**0.880**	**19.128**	**2.104**	

Clock Time (at end of sample period)			
050514 175116			
12:52	0.977	18.909	3.458
12:53	0.788	19.092	3.015
12:54	0.874	19.042	2.720
12:55	0.837	19.129	2.492
12:56	0.924	19.086	2.377
12:57	1.004	18.914	2.222
12:58	0.882	19.044	2.063
12:59	1.004	18.975	2.031
13:00	1.033	18.909	1.952
13:01	0.724	19.219	1.890
13:02	0.665	19.383	1.818
13:03	0.704	19.254	1.761
13:04	0.715	18.883	1.595
13:05	0.828	19.134	1.701
13:06	1.056	18.945	1.751
13:07	0.973	19.008	1.655
13:08	0.942	19.022	1.540
13:09	0.936	19.072	1.436
13:10	0.803	19.147	1.785
13:11	0.765	19.218	2.252
13:12	0.603	19.358	2.179
13:13	0.625	19.349	2.163
13:14	0.838	19.119	2.262
13:15	1.105	18.916	2.277
13:16	1.184	18.828	2.162
13:17	1.077	18.871	2.140
13:18	0.978	19.012	2.174
13:19	0.885	19.096	2.128
13:20	0.938	19.025	2.102
13:21	0.696	19.264	2.148
13:22	0.981	19.031	2.145
13:23	0.952	19.065	2.100
13:24	0.910	19.148	1.806
13:25	0.908	19.078	3.019
13:26	0.799	19.156	4.118
13:27	0.978	19.030	4.233
13:28	1.184	18.873	4.042
13:29	0.999	18.987	3.572
13:30	0.801	19.155	3.275
13:31	0.794	19.214	3.170

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 12:51
Stop time 13:52

REFERENCE METHOD RUN 6

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv	Channel 4
13:32	0.828	19.170	3.125	
13:33	0.832	19.178	2.970	
13:34	0.972	19.018	2.895	
13:35	0.925	19.077	2.861	
13:36	0.984	19.017	2.935	
13:37	0.967	19.006	2.857	
13:38	0.924	19.059	2.848	
13:39	1.054	18.949	2.755	
13:40	0.995	18.974	2.658	
13:41	0.914	19.130	2.592	
13:42	1.083	18.919	2.531	
13:43	1.014	18.950	2.594	
13:44	0.974	19.002	2.640	
13:45	0.868	19.092	2.589	
13:46	1.036	18.991	2.553	
13:47	1.097	18.926	2.327	
13:48	1.109	18.924	2.345	
13:49	1.064	18.947	2.438	
13:50	0.836	19.151	2.455	
13:51	0.833	19.137	2.533	
13:52	0.972	19.025	2.423	

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 13:55
Stop Time 14:04

CALIBRATION BIAS 03

		Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
System Response to Calibration Gasses (C_S)				
C_{of}	Zero gas	0.029	0.074	0.687
C_{uf}	Upscale gas	4.488	18.929	24.461
Analyzer Calibration Error Reponses (C_{Dir})				
C_{oce}	Zero gas	0.004	-0.006	0.112
C_{mce}	Upscale gas	4.535	19.112	24.945
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.3%	0.4%	0.7%
	Upscale gas	-0.5%	-1.0%	-0.6%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	0.083	0.017	0.112
C_{ui}	Upscale gas	4.514	18.935	24.945
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	-0.6%	0.3%	0.7%
	Upscale gas	-0.3%	0.0%	-0.6%
Drift Assessment Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK

050514 175116

13:55:10	20.575	0.090	25.021
13:55:25	20.583	0.080	23.544
13:55:40	20.589	0.070	24.321
13:55:55	20.596	0.063	24.519
13:56:10	20.600	0.054	24.544
13:56:25	20.604	0.050	25.159
13:56:40	20.606	0.047	8.405
13:56:55	20.745	0.045	1.644
13:57:10	20.897	0.043	0.782
13:57:25	20.890	0.026	0.586
13:57:40	20.936	0.037	0.620
13:57:55	20.938	0.034	0.614
13:58:10	20.936	0.031	0.874
13:58:25	13.273	5.412	0.575
13:58:40	2.159	17.169	1.123
13:58:55	0.937	18.880	1.389
13:59:10	0.829	19.074	1.485
13:59:25	0.817	19.128	1.579
13:59:40	0.907	19.087	1.962
13:59:55	4.134	17.109	1.719
14:00:10	4.195	3.481	-0.355
14:00:25	0.289	0.321	-0.542
14:00:40	0.061	0.129	-0.589
14:00:55	0.037	0.089	-0.651
14:01:10	0.028	0.073	-0.682
14:01:25	0.021	0.059	-0.425
14:01:40	1.459	3.364	-0.186
14:01:55	4.191	16.075	-0.287

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 13:55
Stop Time 14:04

CALIBRATION BIAS 03

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
14:02:10	4.460	18.533	-0.330
14:02:25	4.480	18.807	-0.358
14:02:40	4.483	18.832	-0.369
14:02:55	4.481	18.864	-0.386
14:03:10	4.483	18.892	-0.381
14:03:25	4.484	18.907	-0.381
14:03:40	4.487	18.924	-0.373
14:03:55	4.486	18.929	-0.397
14:04:10	4.491	18.933	-0.373
14:04:25	3.855	18.924	0.607

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 14:08
Stop time 15:11

REFERENCE METHOD RUN 7

		Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv	Channel 4
Calibration Checks					
C_{oi}	Initial zero	0.029	0.074	0.687	
C_{ui}	Initial upscale	4.488	18.929	24.461	
C_{of}	Final zero	0.012	0.136	0.318	
C_{uf}	Final upscale	4.478	18.884	23.815	
C_{ma}	Actual gas value	4.540	19.000	24.700	
Analyzer Averages (concentrations)					
C_{Avg}	Average conc.	0.957	19.010	1.455	
C_{Gas}	**Bias adjusted**	**0.953**	**19.105**	**0.995**	

Clock Time (at end of sample period)				
050514 175116				
14:09	0.887	18.920	1.884	
14:10	1.092	18.949	1.941	
14:11	1.130	18.887	1.877	
14:12	1.028	18.990	1.801	
14:13	1.080	18.920	1.728	
14:14	0.980	18.944	1.742	
14:15	0.315	19.139	1.786	
14:16	0.761	19.169	1.810	
14:17	0.935	19.062	1.703	
14:18	0.863	19.138	1.625	
14:19	0.787	19.193	1.580	
14:20	0.872	19.150	1.602	
14:21	0.929	19.074	1.289	
14:22	0.805	19.175	0.947	
14:23	0.940	19.092	1.012	
14:24	1.037	18.969	1.228	
14:25	1.172	18.819	1.352	
14:26	1.218	18.795	1.410	
14:27	4.742	15.558	1.493	moving cem probe
14:28	1.279	18.528	1.497	
14:29	0.977	18.991	1.584	
14:30	1.167	18.813	1.637	
14:31	1.072	18.912	1.266	
14:32	1.136	18.892	1.241	
14:33	0.916	19.014	1.293	
14:34	1.026	18.943	1.236	
14:35	0.861	19.099	1.256	
14:36	0.769	19.190	1.284	
14:37	0.797	19.132	1.381	
14:38	0.680	19.280	1.426	
14:39	0.963	19.019	1.516	
14:40	0.924	19.109	1.436	
14:41	1.045	18.980	1.446	
14:42	0.938	19.036	1.250	
14:43	0.664	19.224	1.157	
14:44	0.766	19.169	1.468	
14:45	1.003	18.996	1.564	
14:46	1.193	18.820	1.618	
14:47	0.992	18.975	1.621	
14:48	0.976	19.027	1.590	

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 14:08
Stop time 15:11

REFERENCE METHOD RUN 7

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv	Channel 4
14:49	0.905	19.062	1.557	
14:50	0.927	19.081	1.630	
14:51	0.960	19.009	1.657	
14:52	0.989	18.998	1.622	
14:53	1.015	18.942	1.660	
14:54	0.907	19.064	1.608	
14:55	0.934	19.038	1.567	
14:56	0.968	19.012	1.621	
14:57	1.061	18.928	1.141	
14:58	1.050	18.966	1.165	
14:59	0.963	19.008	1.241	
15:00	0.817	19.081	1.368	
15:01	1.004	18.974	1.399	
15:02	1.025	18.924	1.458	
15:03	1.215	18.778	1.613	
15:04	1.186	18.777	1.388	
15:05	1.085	18.866	1.311	
15:06	1.030	18.935	1.235	
15:07	0.916	19.073	1.182	
15:08	0.864	19.110	1.194	
15:09	1.077	18.900	1.262	
15:10	0.935	19.020	1.211	
15:11	0.872	19.051	1.186	

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 15:13
Stop Time 15:20

CALIBRATION BIAS 04

		Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
System Response to Calibration Gasses (C_S)				
C_{of}	Zero gas	0.012	0.136	0.318
C_{uf}	Upscale gas	4.478	18.884	23.815
Analyzer Calibration Error Reponses (C_{Dir})				
C_{oce}	Zero gas	0.004	-0.006	0.112
C_{mce}	Upscale gas	4.535	19.112	24.945
Actual Upscale Gas Value (C_{MA})				
C_{ma}	Upscale gas	4.540	19.000	24.700
Calibration Span Value (CS)				
		9.050	19.000	85.600
System Bias as Percent of Calibration Span Value (SB) (5%)				
	Zero gas	0.1%	0.7%	0.2%
	Upscale gas	-0.6%	-1.2%	-1.3%
System Bias Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK
Previous System Response to Calibration Gases (C_S)				
C_{oi}	Zero gas	0.029	0.074	0.687
C_{ui}	Upscale gas	4.488	18.929	24.461
Drift Assessment as Percent of Calibration Span Value (D) (3%)				
	Zero gas	-0.2%	0.3%	-0.4%
	Upscale gas	-0.1%	-0.2%	-0.8%
Drift Assessment Status				
	Zero gas	OK	OK	OK
	Upscale gas	OK	OK	OK

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15:13:42	1.763	8.048	-0.288
15:13:57	0.128	0.777	-0.684
15:14:12	0.022	0.231	-0.863
15:14:27	0.012	0.164	-0.949
15:14:42	0.011	0.128	-1.105
15:14:57	0.013	0.117	-0.707
15:15:12	0.423	6.166	0.321
15:15:27	1.002	17.240	0.941
15:15:42	1.252	18.513	1.322
15:15:57	1.093	17.423	0.972
15:16:12	3.085	14.016	0.291
15:16:27	4.380	18.280	-0.099
15:16:42	4.458	18.801	-0.281
15:16:57	4.469	18.837	-0.371
15:17:11	4.474	18.869	-0.483
15:17:27	4.478	18.885	-0.560
15:17:42	4.481	18.897	-0.376
15:17:57	8.870	15.617	0.243
15:18:12	19.365	2.573	0.300
15:18:27	20.710	0.359	0.334
15:18:42	20.828	0.206	0.247
15:18:57	20.862	0.151	0.352
15:19:12	20.883	0.120	0.356
15:19:27	20.890	0.108	5.434
15:19:42	20.751	0.150	31.057
15:19:57	20.572	0.130	24.837
15:20:12	20.582	0.077	23.865
15:20:26	20.587	0.067	23.702

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Marathon
CleanAir Project No. 12461
Garyville, LA
FCCU Regenerator

March 21, 2014
Start Time 15:13
Stop Time 15:20

CALIBRATION BIAS 04

	Channel 1 O2 FCCU Regenerato %dv	Channel 2 CO2 FCCU Regenerato %dv	Channel 3 THC FCCU Regenerato ppmwv
15:20:42	20.592	0.060	23.878

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PLANT DATA

I

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: PNK

Date: 05/14

CleanAir

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Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/18/2014 10:45	127.29	18.11	69.47	7.10	6.90	7.30	5.70	203.01	252.24	142.71	143.03	29.65	1.53	2.28	33.77
3/18/2014 10:46	127.29	18.11	69.45	7.10	6.90	7.30	5.70	202.73	251.68	142.69	142.97	29.69	1.58	2.43	33.64
3/18/2014 10:47	127.30	18.09	69.49	7.10	6.90	7.30	5.70	203.23	251.57	142.60	142.78	29.71	1.50	2.34	33.59
3/18/2014 10:48	127.30	18.06	69.42	7.10	6.90	7.30	5.70	202.84	250.85	142.59	142.73	29.71	1.41	2.71	34.39
3/18/2014 10:49	127.29	17.97	69.31	7.10	6.90	7.30	5.70	201.91	249.97	142.56	142.54	29.73	1.44	2.54	34.35
3/18/2014 10:50	127.29	18.03	69.23	7.10	6.90	7.30	5.70	202.57	250.80	142.64	142.61	29.69	1.33	2.69	35.33
3/18/2014 10:51	127.29	18.20	68.96	7.10	6.90	7.30	5.70	202.37	251.06	142.86	142.82	29.62	1.28	2.56	33.96
3/18/2014 10:52	127.29	18.20	68.83	7.10	6.90	7.30	5.70	203.24	251.91	142.79	142.79	29.60	1.46	2.30	33.68
3/18/2014 10:53	127.29	18.19	68.66	7.10	6.90	7.30	5.70	203.52	252.05	142.58	142.71	29.52	1.44	2.24	32.84
3/18/2014 10:54	127.28	18.18	68.69	7.10	6.90	7.30	5.70	203.53	252.48	142.59	142.75	29.52	1.61	2.58	32.98
3/18/2014 10:55	127.28	18.16	68.84	7.10	6.90	7.30	5.70	203.61	252.12	142.63	142.86	29.56	1.50	2.51	33.11
3/18/2014 10:56	127.28	18.13	68.98	7.10	6.90	7.30	5.70	202.34	250.84	142.58	142.82	29.65	1.50	2.29	32.53
3/18/2014 10:57	127.28	18.05	69.06	7.10	6.90	7.30	5.70	201.84	250.06	142.45	142.70	29.71	1.50	2.18	33.22
3/18/2014 10:58	127.28	18.06	69.15	7.10	6.90	7.30	5.70	201.18	249.56	142.45	142.72	29.76	1.17	2.10	33.03
3/18/2014 10:59	127.28	18.07	69.17	7.10	6.90	7.30	5.70	201.83	249.58	142.45	142.75	29.78	1.07	2.00	32.29
3/18/2014 11:00	127.27	18.07	69.10	7.10	6.90	7.30	5.70	201.79	249.67	142.43	142.75	29.74	1.14	1.66	31.52
3/18/2014 11:01	127.27	18.06	69.21	7.10	6.90	7.30	5.70	201.60	249.49	142.38	142.75	29.77	1.44	1.59	31.21
3/18/2014 11:02	127.28	18.07	69.39	7.10	6.90	7.30	5.70	201.46	249.23	142.41	142.77	29.71	1.27	1.59	32.33
3/18/2014 11:03	127.28	18.10	69.43	7.10	6.90	7.30	5.70	201.83	250.04	142.50	142.83	29.66	1.24	1.42	31.77
3/18/2014 11:04	127.28	18.10	69.58	7.10	6.90	7.30	5.70	201.68	250.00	142.50	142.83	29.67	1.49	1.28	33.10
3/18/2014 11:05	127.29	18.10	69.65	7.10	6.90	7.30	5.70	201.47	249.70	142.48	142.82	29.71	1.46	1.31	32.66
3/18/2014 11:06	127.29	18.09	69.76	7.10	6.90	7.30	5.70	201.35	249.38	142.51	142.85	29.75	1.31	1.10	31.24
3/18/2014 11:07	127.29	18.07	69.70	7.10	6.90	7.30	5.70	201.89	250.28	142.62	142.92	29.73	1.12	1.07	31.31
3/18/2014 11:08	127.28	18.07	69.49	7.10	6.90	7.30	5.70	202.12	250.12	142.58	142.91	29.68	1.25	0.80	31.05
3/18/2014 11:09	127.28	18.07	69.36	7.10	6.90	7.30	5.70	202.19	249.63	142.63	142.87	29.63	1.43	0.76	30.04
3/18/2014 11:10	127.29	18.12	69.27	7.10	6.90	7.30	5.70	201.78	249.73	142.96	142.80	29.54	1.32	0.82	30.87
3/18/2014 11:11	127.29	18.28	69.21	7.10	6.90	7.30	5.70	201.44	249.42	142.60	142.53	29.51	1.23	0.51	29.58
3/18/2014 11:12	127.29	18.25	69.32	7.10	6.90	7.30	5.70	200.28	247.78	142.61	142.34	29.54	1.30	0.34	29.73
3/18/2014 11:13	127.29	18.16	69.36	7.10	6.90	7.30	5.70	200.22	248.42	142.64	142.41	29.59	1.04	0.36	28.77
3/18/2014 11:14	127.29	18.14	69.37	7.10	6.90	7.30	5.70	200.99	248.60	142.66	142.63	29.54	1.09	0.67	29.71
3/18/2014 11:15	127.29	18.08	69.42	7.10	6.90	7.30	5.70	200.23	247.41	142.72	142.72	29.54	1.11	0.47	29.23
3/18/2014 11:16	127.28	18.10	69.53	7.10	6.90	7.30	5.70	200.51	248.36	142.76	143.04	29.55	1.07	0.42	29.28
3/18/2014 11:17	127.28	18.17	69.55	7.10	6.90	7.30	5.70	201.35	249.08	142.88	143.03	29.46	1.09	0.28	27.76
3/18/2014 11:18	127.29	18.19	69.64	7.10	6.90	7.30	5.70	200.66	248.78	142.88	143.01	29.49	1.01	0.30	28.67
3/18/2014 11:19	127.30	18.25	69.76	7.10	6.90	7.30	5.70	201.43	249.34	142.87	143.03	29.49	0.97	0.25	28.90
3/18/2014 11:20	127.30	18.24	69.88	7.10	6.90	7.30	5.70	201.46	249.21	142.85	143.11	29.48	1.06	0.32	29.57
3/18/2014 11:21	127.30	18.21	70.07	7.10	6.90	7.30	5.70	200.67	248.57	142.80	143.17	29.57	1.26	0.18	29.73
3/18/2014 11:22	127.30	18.22	70.25	7.10	6.90	7.30	5.70	200.37	248.08	142.88	143.35	29.61	1.13	0.18	29.68
3/18/2014 11:23	127.29	18.23	70.30	7.10	6.90	7.30	5.70	201.30	248.82	143.12	143.37	29.59	1.08	0.18	28.10
3/18/2014 11:24	127.30	18.23	70.15	7.10	6.90	7.30	5.70	201.60	249.61	143.15	143.45	29.52	1.10	0.18	28.41
3/18/2014 11:25	127.30	18.22	70.05	7.10	6.90	7.30	5.70	201.61	249.41	143.24	143.48	29.56	1.16	0.19	29.25
3/18/2014 11:26	127.30	18.17	70.08	7.10	6.90	7.30	5.70	202.38	249.31	143.25	143.59	29.58	1.08	0.19	28.67
3/18/2014 11:27	127.29	18.00	70.21	7.10	6.90	7.30	5.70	203.20	250.77	143.31	143.58	29.66	1.15	0.18	28.75
3/18/2014 11:28	127.29	18.04	70.35	7.10	6.90	7.30	5.70	203.11	251.29	143.28	143.54	29.69	1.29	0.18	28.96
3/18/2014 11:29	127.30	18.14	70.20	7.10	6.90	7.30	5.70	204.13	252.69	143.21	143.51	29.64	1.25	0.18	28.96
3/18/2014 11:30	127.30	18.11	70.17	7.10	6.90	7.30	5.70	203.51	251.89	143.21	143.41	29.66	1.21	0.18	28.64
3/18/2014 11:31	127.30	18.01	70.27	7.10	6.90	7.30	5.70	203.17	251.36	143.21	143.40	29.72	1.15	0.19	27.68
3/18/2014 11:32	127.30	18.01	70.26	7.10	6.90	7.30	5.70	202.74	251.03	143.31	143.38	29.72	1.17	0.19	27.81
3/18/2014 11:33	127.30	18.00	70.16	7.10	6.90	7.30	5.70	202.44	250.39	143.58	143.42	29.72	1.05	0.18	28.19
3/18/2014 11:34	127.30	18.03	69.91	7.10	6.90	7.30	5.70	202.42	251.25	143.60	143.53	29.62	0.98	0.18	27.51
3/18/2014 11:35	127.30	18.11	69.76	7.10	6.90	7.30	5.70	202.30	250.42	143.67	143.63	29.55	0.90	0.19	25.72
3/18/2014 11:36	127.30	18.10	69.78	7.10	6.90	7.30	5.70	202.06	250.08	143.71	143.91	29.55	1.02	0.19	26.62
3/18/2014 11:37	127.31	18.06	69.88	7.10	6.90	7.30	5.70	202.28	250.54	143.84	143.97	29.59	0.95	0.19	27.14
3/18/2014 11:38	127.31	18.09	70.02	7.10	6.90	7.30	5.70	203.06	250.83	143.87	144.15	29.58	0.90	0.19	27.42
3/18/2014 11:39	127.30	18.17	70.11	7.10	6.90	7.30	5.70	203.51	251.70	143.98	144.18	29.58	1.15	0.19	27.94
3/18/2014 11:40	127.30	18.12	70.41	7.10	6.90	7.30	5.70	204.34	251.87	143.96	144.26	29.66	1.33	0.19	26.98
3/18/2014 11:41	127.30	17.96	70.53	7.10	6.90	7.30	5.70	203.88	252.24	143.90	144.29	29.69	1.36	0.18	27.17
3/18/2014 11:42	127.30	18.00	70.68	7.10	6.90	7.30	5.70	203.39	251.85	143.91	144.38	29.75	1.39	0.18	28.11
3/18/2014 11:43	127.31	18.13	70.60	7.10	6.90	7.30	5.70	203.30	251.59	143.93	144.35	29.70	1.41	0.18	29.19
3/18/2014 11:44	127.31	18.14	70.27	7.10	6.90	7.30	5.70	202.76	250.74	143.93	144.26	29.62	1.37	0.18	29.06
3/18/2014 11:45	127.30	18.15	69.94	7.10	6.90	7.30	5.70	203.04	250.93	143.92	144.29	29.59	1.20	0.18	28.47
3/18/2014 11:46	127.30	18.19	69.60	7.10	6.90	7.30	5.70	202.92	251.49	143.93	144.37	29.47	1.08	0.18	28.07
3/18/2014 11:47	127.29	18.30	69.32	7.10	6.90	7.30	5.70	203.27	251.33	143.96	144.34	29.45	1.13	0.19	28.64
3/18/2014 11:48	127.29	18.28	69.20	7.10	6.90	7.30	5.70	202.83	250.84	143.94	144.26	29.45	1.24	0.19	28.49
3/18/2014 11:49	127.30	18.24	69.29	7.10	6.90	7.30	5.70	203.06	251.42	143.85	144.22	29.46	1.26	0.18	28.31
3/18/2014 11:50	127.30	18.21	69.54	7.10	6.90	7.30	5.70	203.69	252.56	143.86	144.08	29.60	1.17	0.18	29.22
3/18/2014 11:51	127.28	18.12	69.89	7.10	6.90	7.30	5.70	202.84	250.93	143.89	144.01	29.67	1.36	0.18	28.67

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/18/2014 11:52	127.28	18.11	69.93	7.10	6.90	7.30	5.70	202.74	251.24	143.88	143.78	29.65	1.32	0.18	27.59
3/18/2014 11:53	127.28	18.10	70.03	7.10	6.90	7.30	5.70	202.39	250.27	143.86	143.77	29.69	1.21	0.19	29.25
3/18/2014 11:54	127.28	18.09	70.00	7.10	6.90	7.30	5.70	202.18	249.79	143.84	143.71	29.68	1.26	0.19	29.28
3/18/2014 11:55	127.30	18.03	69.90	7.10	6.90	7.30	5.70	202.31	250.39	143.78	143.76	29.66	1.18	0.19	29.35
3/18/2014 11:56	127.30	18.04	69.89	7.10	6.90	7.30	5.70	202.61	250.66	143.80	143.90	29.69	1.16	0.19	29.32
3/18/2014 11:57	127.31	18.07	69.82	7.10	6.90	7.30	5.70	202.83	250.78	143.85	143.91	29.63	1.19	0.18	29.03
3/18/2014 11:58	127.30	18.09	69.68	7.10	6.90	7.30	5.70	204.09	252.83	143.77	143.95	29.60	1.36	0.18	28.35
3/18/2014 11:59	127.30	18.13	69.79	7.10	6.90	7.30	5.70	203.53	251.98	143.56	143.92	29.60	1.36	0.19	28.65
3/18/2014 12:00	127.30	18.16	69.76	7.10	6.90	7.30	5.70	203.67	251.98	143.53	143.86	29.58	1.44	0.19	29.87
3/18/2014 12:01	127.30	18.27	69.59	7.10	6.90	7.30	5.70	203.31	252.14	143.43	143.83	29.53	1.37	0.19	30.11
3/18/2014 12:02															
Average	127.29	18.12	69.68	7.10	6.90	7.30	5.70	202.37	250.50	143.16	143.35	29.62	1.25	0.79	29.97

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/18/2014 17:56	127.24	17.90	70.55	7.10	6.90	7.30	5.70	198.13	245.28	143.16	143.58	29.73	1.05	0.20	36.21
3/18/2014 17:57	127.23	17.76	70.68	7.10	6.90	7.30	5.70	198.38	244.97	143.13	143.63	29.75	1.12	0.20	36.45
3/18/2014 17:58	127.23	17.81	70.68	7.10	6.90	7.30	5.70	198.70	246.02	143.15	143.57	29.68	1.20	0.20	35.84
3/18/2014 17:59	127.22	17.97	70.67	7.10	6.90	7.30	5.70	198.54	245.69	143.22	143.39	29.66	1.22	0.20	37.23
3/18/2014 18:00	127.21	17.96	70.68	7.10	6.90	7.30	5.70	198.52	245.05	143.21	143.36	29.65	1.11	0.20	36.74
3/18/2014 18:01	127.17	17.94	70.65	7.10	6.90	7.30	5.70	199.16	246.24	143.18	143.28	29.60	1.15	0.20	35.70
3/18/2014 18:02	127.17	17.95	70.52	7.10	6.90	7.30	5.70	199.57	246.68	143.16	143.22	29.57	1.24	0.20	36.81
3/18/2014 18:03	127.16	18.01	70.53	7.10	6.90	7.30	5.70	198.90	246.57	143.12	143.07	29.60	1.33	0.20	36.12
3/18/2014 18:04	127.16	17.97	70.63	7.10	6.90	7.30	5.70	198.76	246.06	143.13	143.13	29.69	1.19	0.20	36.27
3/18/2014 18:05	127.15	17.86	70.77	7.10	6.90	7.30	5.70	198.45	245.53	143.17	143.33	29.73	1.19	0.20	38.01
3/18/2014 18:06	127.15	17.86	70.74	7.10	6.90	7.30	5.70	198.84	245.68	143.18	143.39	29.71	1.15	0.20	36.01
3/18/2014 18:07	127.15	17.87	70.61	7.10	6.90	7.30	5.70	199.20	246.11	143.20	143.57	29.68	1.10	0.20	35.92
3/18/2014 18:08	127.15	17.87	70.53	7.10	6.90	7.30	5.70	198.79	246.07	143.21	143.59	29.66	1.16	0.20	36.22
3/18/2014 18:09	127.15	17.89	70.50	7.10	6.90	7.30	5.70	198.93	245.95	143.24	143.64	29.67	1.17	0.20	37.37
3/18/2014 18:10	127.15	17.92	70.63	7.10	6.90	7.30	5.70	199.25	245.76	143.26	143.67	29.71	1.30	0.20	35.19
3/18/2014 18:11	127.14	18.00	70.67	7.10	6.90	7.30	5.70	198.79	245.18	143.32	143.75	29.66	1.13	0.20	34.93
3/18/2014 18:12	127.13	18.00	70.65	7.10	6.90	7.30	5.70	198.17	244.98	143.31	143.69	29.64	1.19	0.20	36.97
3/18/2014 18:13	127.11	18.02	70.77	7.10	6.90	7.30	5.70	198.06	244.56	143.29	143.51	29.70	1.17	0.20	36.61
3/18/2014 18:14	127.10	18.03	70.80	7.10	6.90	7.30	5.70	197.93	245.41	143.33	143.47	29.72	1.13	0.20	35.79
3/18/2014 18:15	127.09	18.03	70.83	7.10	6.90	7.30	5.70	198.54	245.94	143.45	143.36	29.69	1.08	0.20	36.00
3/18/2014 18:16	127.09	18.03	70.69	7.10	6.90	7.30	5.70	198.45	245.92	143.39	143.32	29.66	1.23	0.20	34.69
3/18/2014 18:17	127.07	18.02	70.67	7.10	6.90	7.30	5.70	198.28	245.63	143.21	143.20	29.69	1.35	0.20	36.00
3/18/2014 18:18	127.07	17.99	70.78	7.10	6.90	7.30	5.70	198.00	245.09	143.27	143.32	29.72	1.37	0.20	36.33
3/18/2014 18:19	127.06	17.92	70.80	7.10	6.90	7.30	5.70	198.60	245.46	143.45	143.65	29.69	1.18	0.20	35.30
3/18/2014 18:20	127.06	17.94	70.67	7.10	6.90	7.30	5.70	198.52	245.27	143.45	143.65	29.67	1.28	0.20	36.63
3/18/2014 18:21	127.05	18.00	70.49	7.10	6.90	7.30	5.70	198.90	245.85	143.43	143.64	29.59	1.27	0.20	36.08
3/18/2014 18:22	127.05	17.96	70.38	7.10	6.90	7.30	5.70	198.78	245.74	143.42	143.68	29.62	1.37	0.20	35.93
3/18/2014 18:23	127.05	17.84	70.47	7.10	6.90	7.30	5.70	197.88	245.43	143.40	143.78	29.74	1.32	0.20	35.50
3/18/2014 18:24	127.05	17.84	70.74	7.10	6.90	7.30	5.70	197.62	245.05	143.42	143.84	29.78	1.15	0.20	35.24
3/18/2014 18:25	127.05	17.84	70.68	7.10	6.90	7.30	5.70	197.80	244.06	143.49	144.01	29.71	1.22	0.20	34.73
3/18/2014 18:26	127.04	17.88	70.47	7.10	6.90	7.30	5.70	197.01	244.49	143.50	143.97	29.67	1.02	0.20	34.97
3/18/2014 18:27	127.03	17.98	70.38	7.10	6.90	7.30	5.70	197.55	244.38	143.54	143.84	29.64	1.10	0.20	34.53
3/18/2014 18:28	127.03	17.97	70.46	7.10	6.90	7.30	5.70	197.52	244.23	143.55	143.76	29.65	1.17	0.20	37.29
3/18/2014 18:29	127.03	17.92	70.55	7.10	6.90	7.30	5.70	197.24	244.49	143.57	143.53	29.70	1.21	0.20	35.24
3/18/2014 18:30	127.03	17.91	70.79	7.10	6.90	7.30	5.70	196.92	243.89	143.54	143.51	29.71	1.19	0.20	35.07
3/18/2014 18:31	127.05	17.91	70.72	7.10	6.90	7.30	5.70	197.62	244.34	143.43	143.42	29.65	1.26	0.20	34.54
3/18/2014 18:32	127.04	17.90	70.72	7.10	6.90	7.30	5.70	197.70	244.01	143.44	143.46	29.64	1.31	0.20	35.14
3/18/2014 18:33	127.04	17.88	70.74	7.10	6.90	7.30	5.70	197.59	244.40	143.47	143.59	29.70	1.17	0.20	36.94
3/18/2014 18:34	127.04	17.90	70.77	7.10	6.90	7.30	5.70	197.36	243.71	143.49	143.64	29.69	1.14	0.23	37.04
3/18/2014 18:35	127.03	17.97	70.66	7.10	6.90	7.30	5.70	197.62	243.97	143.53	143.83	29.65	1.01	0.48	37.09
3/18/2014 18:36	127.04	17.98	70.52	7.10	6.90	7.30	5.70	197.45	244.74	143.55	143.87	29.58	1.00	1.07	36.40
3/18/2014 18:37	127.05	17.99	70.39	7.10	6.90	7.30	5.70	197.64	244.75	143.60	143.99	29.50	1.14	1.43	36.79
3/18/2014 18:38	127.05	17.97	70.40	7.10	6.90	7.30	5.70	197.92	244.78	143.57	143.98	29.53	1.14	1.51	37.81
3/18/2014 18:39	127.05	17.92	70.73	7.10	6.90	7.30	5.70	197.72	244.52	143.46	143.94	29.64	1.21	1.69	37.74
3/18/2014 18:40	127.05	17.93	70.97	7.10	6.90	7.30	5.70	197.59	243.74	143.51	143.94	29.69	1.15	1.65	38.72
3/18/2014 18:41	127.03	17.96	71.10	7.10	6.90	7.30	5.70	197.08	243.73	143.63	143.95	29.74	1.11	2.07	38.38
3/18/2014 18:42	127.04	17.93	71.14	7.10	6.90	7.30	5.70	196.83	243.39	143.64	143.89	29.73	1.22	1.98	39.83
3/18/2014 18:43	127.04	17.85	71.04	7.10	6.90	7.30	5.70	197.05	242.82	143.67	143.71	29.70	1.08	2.01	39.65
3/18/2014 18:44	127.05	17.88	71.00	7.10	6.90	7.30	5.70	196.93	244.08	143.68	143.70	29.67	0.98	2.43	38.79
3/18/2014 18:45	127.05	17.96	70.81	7.10	6.90	7.30	5.70	198.08	245.21	143.70	143.67	29.64	0.89	2.37	37.81
3/18/2014 18:46	127.05	17.99	70.58	7.10	6.90	7.30	5.70	198.47	246.43	143.64	143.62	29.52	1.07	2.86	38.25
3/18/2014 18:47	127.05	18.07	70.49	7.10	6.90	7.30	5.70	198.69	245.96	143.45	143.49	29.48	1.23	2.92	39.70
3/18/2014 18:48	127.04	18.03	70.52	7.10	6.90	7.30	5.70	198.50	246.08	143.45	143.54	29.48	1.30	3.03	39.52
3/18/2014 18:49	127.04	17.91	70.87	7.10	6.90	7.30	5.70	197.92	246.17	143.45	143.68	29.65	1.26	2.86	39.39
3/18/2014 18:50	127.04	17.94	71.10	7.10	6.90	7.30	5.70	197.90	245.33	143.48	143.74	29.76	1.12	2.89	40.59
3/18/2014 18:51	127.05	18.04	71.14	7.10	6.90	7.30	5.70	197.96	245.45	143.57	143.94	29.74	1.06	2.70	40.18
3/18/2014 18:52	127.05	18.01	70.98	7.10	6.90	7.30	5.70	198.29	245.81	143.53	143.93	29.72	0.95	2.37	38.93
3/18/2014 18:53	127.05	17.92	70.86	7.10	6.90	7.30	5.70	198.24	245.50	143.44	143.91	29.67	1.02	2.10	38.91
3/18/2014 18:54	127.05	17.94	70.87	7.10	6.90	7.30	5.70	198.44	244.55	143.44	143.91	29.68	1.19	2.05	38.86
3/18/2014 18:55	127.05	18.02	70.88	7.10	6.90	7.30	5.70	198.39	244.94	143.42	143.93	29.64	1.16	1.71	38.74
3/18/2014 18:56	127.05	17.99	70.90	7.10	6.90	7.30	5.70	198.58	246.14	143.41	143.81	29.61	1.20	1.73	38.55
3/18/2014 18:57	127.06	17.92	70.93	7.10	6.90	7.30	5.70	198.58	245.99	143.39	143.45	29.65	1.23	1.42	39.15
3/18/2014 18:58	127.06	17.94	70.90	7.10	6.90	7.30	5.70	198.45	245.56	143.40	143.41	29.64	1.29	1.24	38.22
3/18/2014 18:59	127.06	18.02	70.78	7.10	6.90	7.30	5.70	198.15	245.50	143.42	143.27	29.61	1.29	1.41	35.87
3/18/2014 19:00	127.06	18.02	70.74	7.10	6.90	7.30	5.70	198.54	245.49	143.41	143.32	29.64	1.22	1.49	37.82
3/18/2014 19:01	127.06	18.00	70.80	7.10	6.90	7.30	5.70	198.71	245.83	143.38	143.46	29.66	1.24	1.45	38.85
3/18/2014 19:02	127.06	18.00	70.79	7.10	6.90	7.30	5.70	198.44	245.10	143.39	143.52	29.71	1.20	1.72	37.81

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI5014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/18/2014 19:03	127.05	18.01	70.72	7.10	6.90	7.30	5.70	198.83	245.08	143.45	143.70	29.69	1.13	1.39	37.05
3/18/2014 19:04	127.05	17.98	70.58	7.10	6.90	7.30	5.70	198.28	245.03	143.45	143.73	29.69	1.18	0.92	37.94
3/18/2014 19:05	127.04	17.90	70.57	7.10	6.90	7.30	5.70	197.74	244.98	143.45	143.81	29.70	1.15	0.96	38.22
3/18/2014 19:06	127.04	17.94	70.71	7.10	6.90	7.30	5.70	197.21	244.67	143.49	143.84	29.72	1.04	1.06	36.48
3/18/2014 19:07	127.05	18.09	70.88	7.10	6.90	7.30	5.70	197.70	244.34	143.60	143.92	29.76	1.12	1.13	35.61
3/18/2014 19:08	127.05	18.08	70.78	7.10	6.90	7.30	5.70	198.50	245.19	143.60	143.91	29.71	1.12	1.53	36.00
3/18/2014 19:09	127.05	18.08	70.72	7.10	6.90	7.30	5.70	198.57	246.03	143.59	143.84	29.67	1.14	1.21	38.49
3/18/2014 19:10															
Average	127.08	17.95	70.72	7.10	6.90	7.30	5.70	198.16	245.16	143.42	143.64	29.67	1.17	0.96	37.05

Time	CORRECTED REACTOR FEED MBPD 2SF3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBER STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/19/2014 9:14	127.15	18.64	69.48	7.10	6.90	6.30	5.80	199.79	247.24	144.47	144.62	29.51	1.03	1.95	29.60
3/19/2014 9:15	127.16	18.77	69.48	7.10	6.90	6.30	5.80	200.56	248.20	144.42	144.51	29.47	1.14	1.75	30.21
3/19/2014 9:16	127.16	18.78	69.54	7.10	6.90	6.30	5.80	200.96	248.69	144.24	144.16	29.44	1.17	1.65	30.30
3/19/2014 9:17	127.15	18.81	69.68	7.10	6.90	6.30	5.80	200.52	248.11	144.20	144.12	29.44	1.22	1.50	30.40
3/19/2014 9:18	127.15	18.76	69.82	7.10	6.90	6.30	5.80	200.62	248.16	144.07	143.99	29.46	1.32	1.66	29.28
3/19/2014 9:19	127.16	18.62	69.84	7.10	6.90	6.30	5.80	200.64	248.30	144.04	144.01	29.49	1.22	1.58	29.03
3/19/2014 9:20	127.16	18.62	69.92	7.10	6.90	6.30	5.80	200.69	248.34	143.94	144.08	29.51	1.28	1.22	31.83
3/19/2014 9:21	127.15	18.62	69.98	7.10	6.90	6.30	5.80	200.69	248.45	144.01	144.14	29.58	1.13	1.78	29.96
3/19/2014 9:22	127.15	18.63	69.98	7.10	6.90	6.30	5.80	200.66	248.38	144.21	144.34	29.56	1.09	1.58	30.50
3/19/2014 9:23	127.15	18.69	69.95	7.10	6.90	6.30	5.80	200.53	248.15	144.21	144.36	29.57	1.06	1.42	30.42
3/19/2014 9:24	127.15	18.66	69.86	7.10	6.90	6.30	5.80	200.40	248.00	144.21	144.44	29.60	1.01	1.73	29.75
3/19/2014 9:25	127.15	18.59	69.86	7.10	6.90	6.30	5.80	200.14	247.68	144.20	144.45	29.59	1.04	1.58	28.43
3/19/2014 9:26	127.15	18.61	69.89	7.10	6.90	6.30	5.80	200.49	248.10	144.16	144.49	29.56	1.17	1.84	28.29
3/19/2014 9:27	127.16	18.68	70.02	7.10	6.90	6.30	5.80	200.05	247.45	144.12	144.47	29.54	1.26	1.58	29.25
3/19/2014 9:28	127.16	18.68	70.17	7.10	6.90	6.30	5.80	200.35	247.54	144.00	144.40	29.58	1.27	1.66	29.66
3/19/2014 9:29	127.15	18.68	70.22	7.10	6.90	6.30	5.80	200.27	247.85	144.06	144.45	29.62	1.11	1.31	30.93
3/19/2014 9:30	127.15	18.69	70.20	7.10	6.90	6.30	5.80	200.11	247.90	144.24	144.60	29.58	1.06	1.46	29.44
3/19/2014 9:31	127.14	18.72	70.09	7.10	6.90	6.30	5.80	200.40	248.08	144.24	144.57	29.45	1.05	1.84	27.57
3/19/2014 9:32	127.15	18.71	69.88	7.10	6.90	6.30	5.80	200.49	248.33	144.25	144.43	29.43	1.07	1.64	28.65
3/19/2014 9:33	127.16	18.69	69.79	7.10	6.90	6.30	5.80	201.30	249.11	144.24	144.21	29.46	1.25	1.75	27.71
3/19/2014 9:34	127.15	18.69	69.89	7.10	6.90	6.30	5.80	200.91	248.63	144.19	144.21	29.46	1.18	1.77	28.31
3/19/2014 9:35	127.14	18.69	70.05	7.10	6.90	6.30	5.80	199.82	247.18	144.19	144.21	29.52	1.09	1.42	29.85
3/19/2014 9:36	127.14	18.68	70.27	7.10	6.90	6.30	5.80	199.98	247.15	144.19	144.22	29.63	1.10	1.13	29.16
3/19/2014 9:37	127.14	18.65	70.50	7.10	6.90	6.30	5.80	199.92	247.40	144.20	144.26	29.65	1.31	1.30	29.10
3/19/2014 9:38	127.14	18.65	70.44	7.10	6.90	6.30	5.80	200.89	248.60	144.27	144.29	29.59	1.08	1.18	28.37
3/19/2014 9:39	127.13	18.63	70.41	7.10	6.90	6.30	5.80	201.18	249.01	144.21	144.41	29.49	1.07	1.26	27.40
3/19/2014 9:40	127.13	18.69	70.25	7.10	6.90	6.30	5.80	201.06	248.97	144.05	144.34	29.44	1.20	0.99	29.94
3/19/2014 9:41	127.14	18.86	69.99	7.10	6.90	6.30	5.80	201.15	248.82	144.00	144.14	29.40	1.44	0.74	29.28
3/19/2014 9:42	127.14	18.83	69.99	7.10	6.90	6.30	5.80	201.25	248.68	143.87	144.16	29.43	1.40	0.65	30.10
3/19/2014 9:43	127.15	18.72	70.16	7.10	6.90	6.30	5.80	200.56	248.20	143.88	144.23	29.53	1.22	1.32	28.03
3/19/2014 9:44	127.15	18.70	70.11	7.10	6.90	6.30	5.80	200.34	247.92	143.90	144.23	29.54	1.16	0.81	28.60
3/19/2014 9:45	127.13	18.61	70.12	7.10	6.90	6.30	5.80	199.45	246.82	143.88	144.24	29.62	1.12	0.73	30.47
3/19/2014 9:46	127.14	18.60	70.10	7.10	6.90	6.30	5.80	199.13	246.43	143.84	144.21	29.70	1.08	0.83	30.10
3/19/2014 9:47	127.14	18.57	70.02	7.10	6.90	6.30	5.80	199.86	247.28	143.86	144.12	29.62	1.23	1.18	28.90
3/19/2014 9:48	127.14	18.62	70.14	7.10	6.90	6.30	5.80	200.07	247.44	143.95	144.10	29.62	1.22	1.18	29.27
3/19/2014 9:49	127.14	18.77	70.03	7.10	6.90	6.30	5.80	200.42	247.95	143.95	144.02	29.50	1.26	1.03	30.02
3/19/2014 9:50	127.14	18.74	69.89	7.10	6.90	6.30	5.80	200.52	247.91	143.94	143.98	29.45	1.16	1.05	28.83
3/19/2014 9:51	127.14	18.64	69.93	7.10	6.90	6.30	5.80	200.23	247.78	143.92	143.86	29.52	1.29	0.60	29.47
3/19/2014 9:52	127.14	18.66	70.02	7.10	6.90	6.30	5.80	200.29	247.86	143.82	143.91	29.49	1.32	0.74	28.51
3/19/2014 9:53	127.13	18.75	69.94	7.10	6.90	6.30	5.80	200.43	248.09	143.89	144.08	29.48	1.21	0.60	28.72
3/19/2014 9:54	127.13	18.74	69.90	7.10	6.90	6.30	5.80	200.37	248.17	144.14	144.15	29.52	1.24	0.67	28.89
3/19/2014 9:55	127.13	18.73	69.78	7.10	6.90	6.30	5.80	200.71	248.43	144.11	144.38	29.50	1.23	0.95	27.42
3/19/2014 9:56	127.13	18.72	69.79	7.10	6.90	6.30	5.80	200.35	248.08	144.01	144.37	29.55	1.43	0.46	28.39
3/19/2014 9:57	127.13	18.67	69.87	7.10	6.90	6.30	5.80	199.51	246.94	144.03	144.34	29.58	1.36	0.17	30.07
3/19/2014 9:58	127.13	18.69	70.02	7.10	6.90	6.30	5.80	199.51	247.05	144.07	144.42	29.59	1.18	0.23	30.29
3/19/2014 9:59	127.14	18.73	69.98	7.10	6.90	6.30	5.80	199.93	247.41	144.11	144.66	29.55	0.99	0.37	28.77
3/19/2014 10:00	127.14	18.71	69.84	7.10	6.90	6.30	5.80	199.99	247.49	144.23	144.66	29.54	1.09	0.18	28.95
3/19/2014 10:01	127.13	18.63	69.75	7.10	6.90	6.30	5.80	200.21	247.76	144.23	144.65	29.50	1.03	0.21	29.15
3/19/2014 10:02	127.13	18.64	69.73	7.10	6.90	6.30	5.80	200.14	247.68	144.22	144.59	29.48	1.03	0.28	27.87
3/19/2014 10:03	127.15	18.68	69.87	7.10	6.90	6.30	5.80	199.71	247.14	144.18	144.40	29.52	1.25	0.27	28.01
3/19/2014 10:04	127.15	18.69	70.11	7.10	6.90	6.30	5.80	199.03	246.21	144.03	144.36	29.54	1.10	0.23	28.45
3/19/2014 10:05	127.15	18.72	70.22	7.10	6.90	6.30	5.80	199.41	246.50	144.08	144.22	29.52	0.98	0.18	28.29
3/19/2014 10:06	127.15	18.72	70.18	7.10	6.90	6.30	5.80	200.12	247.65	144.25	144.19	29.49	1.08	0.20	27.54
3/19/2014 10:07	127.15	18.76	70.04	7.10	6.90	6.30	5.80	200.73	248.36	144.18	144.08	29.42	1.04	0.27	26.92
3/19/2014 10:08	127.15	18.73	69.96	7.10	6.90	6.30	5.80	200.68	248.20	143.97	144.11	29.50	1.27	0.25	27.46
3/19/2014 10:09	127.13	18.65	70.08	7.10	6.90	6.30	5.80	199.93	247.42	143.98	144.19	29.55	1.27	0.16	27.36
3/19/2014 10:10	127.14	18.64	70.22	7.10	6.90	6.30	5.80	199.62	247.03	144.03	144.22	29.59	1.31	0.16	27.04
3/19/2014 10:11	127.14	18.64	70.21	7.10	6.90	6.30	5.80	200.73	248.41	144.02	144.33	29.52	1.16	0.17	27.27
3/19/2014 10:12	127.14	18.65	70.14	7.10	6.90	6.30	5.80	199.98	247.48	143.98	144.33	29.56	1.20	0.17	28.34
3/19/2014 10:13	127.14	18.68	70.00	7.10	6.90	6.30	5.80	199.74	247.18	144.03	144.32	29.57	1.16	0.17	28.50
3/19/2014 10:14	127.14	18.69	69.95	7.10	6.90	6.30	5.80	200.34	247.93	144.17	144.33	29.54	1.12	0.17	26.27
3/19/2014 10:15	127.14	18.72	70.11	7.10	6.90	6.30	5.80	199.10	246.39	144.17	144.36	29.61	1.49	0.17	28.07
3/19/2014 10:16	127.14	18.72	70.14	7.10	6.90	6.30	5.80	199.05	246.33	144.17	144.42	29.61	1.09	0.17	27.84
3/19/2014 10:17	127.14	18.72	70.20	7.10	6.90	6.30	5.80	199.07	246.35	144.19	144.61	29.53	1.08	0.17	26.63
3/19/2014 10:18	127.14	18.74	70.04	7.10	6.90	6.30	5.80	199.69	247.00	144.25	144.56	29.46	1.00	0.17	25.91
3/19/2014 10:19	127.15	18.80	69.93	7.10	6.90	6.30	5.80	199.90	247.00	144.27	144.41	29.49	1.16	0.17	28.04
3/19/2014 10:20	127.15	18.76	69.96	7.10	6.90	6.30	5.80	199.87	247.34	144.34	144.40	29.54	1.21	0.17	25.95

Time	CORRECTED REACTOR FEED MBPD 2SF3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 2SCokeBR	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/19/2014 10:21	127.14	18.63	70.11	7.10	6.90	6.30	5.80	200.28	247.84	144.34	144.40	29.59	1.27	0.17	25.71
3/19/2014 10:22	127.14	18.62	70.33	7.10	6.90	6.30	5.80	198.99	246.25	144.36	144.43	29.53	1.09	0.17	27.36
3/19/2014 10:23	127.15	18.59	70.40	7.10	6.90	6.30	5.80	199.49	246.75	144.40	144.50	29.54	1.22	0.17	27.23
3/19/2014 10:24															
Average	127.14	18.69	70.01	7.10	6.90	6.30	5.80	200.19	247.71	144.12	144.31	29.53	1.17	0.86	28.68

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	*Unit 30 Scrubber 02* spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER *FEED CORR.* MSCF 25Airtot	THROAT *VELOCITY* feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 *ppm* 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/19/2014 11:23	127.11	20.69	70.81	7.10	6.90	6.30	5.80	198.23	245.31	143.95	143.97	29.63	1.04	0.22	27.33
3/19/2014 11:24	127.10	20.76	70.70	7.10	6.90	6.30	5.80	198.74	245.94	144.11	144.19	29.53	0.93	0.24	26.53
3/19/2014 11:25	127.06	20.72	70.67	7.10	6.90	6.30	5.80	198.27	245.47	144.12	144.22	29.56	1.07	0.19	28.05
3/19/2014 11:26	126.94	20.64	70.85	7.10	6.90	6.30	5.80	197.97	245.33	144.16	144.34	29.64	1.13	0.19	27.43
3/19/2014 11:27	126.85	20.84	70.93	7.10	6.90	6.30	5.80	197.87	244.89	144.19	144.39	29.57	1.07	0.20	28.18
3/19/2014 11:28	126.86	20.80	70.88	7.10	6.90	6.30	5.80	197.66	244.72	144.27	144.54	29.59	1.05	0.20	27.89
3/19/2014 11:29	126.87	20.68	70.95	7.10	6.90	6.30	5.80	197.10	243.91	144.27	144.59	29.65	1.18	0.18	28.77
3/19/2014 11:30	126.89	20.71	70.95	7.10	6.90	6.30	5.80	196.56	243.16	144.27	144.76	29.63	1.08	0.18	27.88
3/19/2014 11:31	126.99	20.80	70.86	7.10	6.90	6.30	5.80	196.80	243.29	144.30	144.74	29.56	1.09	0.19	28.06
3/19/2014 11:32	127.07	20.81	70.64	7.10	6.90	6.30	5.80	196.88	243.72	144.42	144.67	29.53	0.92	0.19	26.07
3/19/2014 11:33	127.14	20.85	70.73	7.10	6.90	6.30	5.80	196.48	243.40	144.46	144.65	29.55	0.67	0.18	25.98
3/19/2014 11:34	127.17	20.83	70.77	7.10	6.90	6.30	5.80	196.04	242.60	144.60	144.59	29.59	0.58	0.18	23.81
3/19/2014 11:35	127.23	20.76	70.66	7.10	6.90	6.30	5.80	196.96	243.73	144.50	144.46	29.45	0.85	0.19	26.46
3/19/2014 11:36	127.24	20.79	70.33	7.10	6.90	6.30	5.80	198.05	245.09	144.15	144.03	29.33	1.02	0.19	26.65
3/19/2014 11:37	127.27	20.86	70.45	7.10	6.90	6.30	5.80	198.54	245.70	144.05	144.00	29.38	1.16	0.19	27.26
3/19/2014 11:38	127.28	20.83	70.74	7.10	6.90	6.30	5.80	197.91	244.91	143.70	143.89	29.45	1.28	0.19	27.38
3/19/2014 11:39	127.32	20.75	71.04	7.10	6.90	6.30	5.80	197.57	244.49	143.71	143.91	29.54	1.21	0.19	27.41
3/19/2014 11:40	127.32	20.76	71.08	7.10	6.90	6.30	5.80	197.60	244.54	143.75	143.97	29.53	1.10	0.19	26.03
3/19/2014 11:41	127.34	20.79	70.92	7.10	6.90	6.30	5.80	197.60	244.53	143.74	143.98	29.50	0.86	0.19	25.12
3/19/2014 11:42	127.34	20.78	70.72	7.10	6.90	6.30	5.80	197.28	244.03	143.70	144.04	29.55	0.90	0.19	25.33
3/19/2014 11:43	127.34	20.74	70.53	7.10	6.90	6.30	5.80	197.74	244.37	143.69	144.06	29.51	1.00	0.19	25.72
3/19/2014 11:44	127.35	20.77	70.39	7.10	6.90	6.30	5.80	198.50	245.65	143.65	144.09	29.47	1.00	0.19	25.07
3/19/2014 11:45	127.36	20.86	70.42	7.10	6.90	6.30	5.80	199.54	246.93	143.60	143.99	29.44	1.10	0.19	26.24
3/19/2014 11:46	127.35	20.83	70.43	7.10	6.90	6.30	5.80	201.17	248.95	143.45	143.64	29.56	1.13	0.19	26.11
3/19/2014 11:47	127.32	20.73	70.86	7.10	6.90	6.30	5.80	200.54	248.10	143.46	143.60	29.63	1.45	0.18	28.10
3/19/2014 11:48	127.32	20.75	71.00	7.10	6.90	6.30	5.80	200.78	248.24	143.51	143.47	29.61	1.14	0.18	26.67
3/19/2014 11:49	127.30	20.79	70.86	7.10	6.90	6.30	5.80	200.98	248.71	143.48	143.44	29.56	1.03	0.19	25.62
3/19/2014 11:50	127.31	20.79	70.72	7.10	6.90	6.30	5.80	200.48	248.09	143.36	143.34	29.61	1.12	0.19	26.53
3/19/2014 11:51	127.31	20.80	70.66	7.10	6.90	6.30	5.80	199.00	246.26	143.38	143.40	29.60	1.13	0.20	26.11
3/19/2014 11:52	127.31	20.80	70.71	7.10	6.90	6.30	5.80	199.71	247.15	143.44	143.59	29.61	0.99	0.20	24.92
3/19/2014 11:53	127.31	20.81	70.74	7.10	6.90	6.30	5.80	200.09	247.73	143.43	143.61	29.65	1.12	0.19	26.10
3/19/2014 11:54	127.30	20.80	70.85	7.10	6.90	6.30	5.80	199.59	247.37	143.40	143.68	29.63	1.22	0.19	27.97
3/19/2014 11:55	127.29	20.77	70.94	7.10	6.90	6.30	5.80	198.80	246.01	143.40	143.71	29.65	1.20	0.19	27.99
3/19/2014 11:56	127.28	20.74	71.05	7.10	6.90	6.30	5.80	198.15	245.21	143.38	143.78	29.72	1.18	0.19	28.20
3/19/2014 11:57	127.28	20.62	71.04	7.10	6.90	6.30	5.80	197.61	244.55	143.43	143.84	29.74	1.06	0.20	28.64
3/19/2014 11:58	127.28	20.63	70.96	7.10	6.90	6.30	5.80	198.37	245.48	143.61	144.06	29.66	1.03	0.20	27.42
3/19/2014 11:59	127.28	20.64	70.72	7.10	6.90	6.30	5.80	198.84	245.98	143.58	143.98	29.61	0.99	0.20	24.41
3/19/2014 12:00	127.28	20.64	70.57	7.10	6.90	6.30	5.80	199.06	246.07	143.46	143.66	29.59	1.24	0.20	28.12
3/19/2014 12:01	127.28	20.65	70.65	7.10	6.90	6.30	5.80	198.75	245.96	143.45	143.45	29.69	1.42	0.20	29.67
3/19/2014 12:02	127.28	20.65	70.97	7.10	6.90	6.30	5.80	197.64	244.57	143.41	143.45	29.71	1.52	0.20	29.49
3/19/2014 12:03	127.28	20.63	71.07	7.10	6.90	6.30	5.80	197.37	244.17	143.48	143.44	29.65	1.31	0.20	28.90
3/19/2014 12:04	127.28	20.68	70.75	7.10	6.90	6.30	5.80	197.32	243.94	143.69	143.45	29.54	1.28	0.20	28.81
3/19/2014 12:05	127.28	20.83	70.39	7.10	6.90	6.30	5.80	196.62	243.32	143.64	143.48	29.56	1.36	0.20	28.70
3/19/2014 12:06	127.28	20.82	70.20	7.10	6.90	6.30	5.80	197.19	244.02	143.49	143.52	29.52	1.36	0.20	29.32
3/19/2014 12:07	127.27	20.79	69.95	7.10	6.90	6.30	5.80	197.28	244.14	143.51	143.67	29.51	1.33	0.20	29.47
3/19/2014 12:08	127.27	20.78	69.99	7.10	6.90	6.30	5.80	195.87	242.39	143.60	143.74	29.57	1.46	0.20	29.31
3/19/2014 12:09	127.27	20.75	70.11	7.10	6.90	6.30	5.80	196.31	242.93	143.63	143.97	29.63	1.42	0.20	27.35
3/19/2014 12:10	127.27	20.73	70.10	7.10	6.90	6.30	5.80	196.08	242.65	143.71	143.97	29.68	1.32	0.20	28.26
3/19/2014 12:11	127.26	20.67	70.07	7.10	6.90	6.30	5.80	195.13	241.47	143.70	143.99	29.72	1.48	0.20	28.47
3/19/2014 12:12	127.26	20.68	70.03	7.10	6.90	6.30	5.80	194.54	240.66	143.69	144.05	29.67	1.47	0.20	28.98
3/19/2014 12:13	127.26	20.70	69.86	7.10	6.90	6.30	5.80	194.60	240.57	143.74	144.24	29.60	1.30	0.20	28.55
3/19/2014 12:14	127.26	20.72	69.66	7.10	6.90	6.30	5.80	194.27	240.41	143.91	144.23	29.52	1.46	0.20	28.96
3/19/2014 12:15	127.25	20.77	69.59	7.10	6.90	6.30	5.80	194.62	240.91	143.95	144.17	29.54	1.46	0.20	28.30
3/19/2014 12:16	127.26	20.78	69.54	7.10	6.90	6.30	5.80	194.30	240.68	144.08	144.14	29.51	1.23	0.20	27.58
3/19/2014 12:17	127.27	20.81	69.63	7.10	6.90	6.30	5.80	193.48	239.43	144.06	144.04	29.58	1.23	0.19	28.13
3/19/2014 12:18	127.27	20.80	69.81	7.10	6.90	6.30	5.80	191.95	237.53	143.97	144.07	29.67	1.09	0.19	29.49
3/19/2014 12:19	127.26	20.76	69.75	7.10	6.90	6.30	5.80	191.37	236.83	144.05	144.25	29.45	0.82	0.20	26.45
3/19/2014 12:20	127.26	20.81	69.51	7.10	6.90	6.30	5.80	192.28	237.94	144.30	144.44	29.32	0.62	0.20	21.94
3/19/2014 12:21	127.27	20.96	69.42	7.10	6.90	6.30	5.80	192.41	238.11	144.26	144.23	29.30	0.75	0.20	25.04
3/19/2014 12:22	127.26	20.97	69.57	7.10	6.90	6.30	5.80	193.03	238.87	144.10	144.28	29.26	0.72	0.20	26.56
3/19/2014 12:23	127.25	21.00	69.93	7.10	6.90	6.30	5.80	193.39	239.32	144.08	144.48	29.36	0.88	0.20	26.37
3/19/2014 12:24	127.25	20.96	70.40	7.10	6.90	6.30	5.80	192.89	238.71	143.99	144.48	29.40	0.89	0.20	26.15
3/19/2014 12:25	127.26	20.81	70.81	7.10	6.90	6.30	5.80	193.57	239.62	143.98	144.50	29.47	0.93	0.20	27.30
3/19/2014 12:26	127.26	20.78	71.08	7.10	6.90	6.30	5.80	193.42	239.62	143.97	144.47	29.51	1.05	0.20	26.56
3/19/2014 12:27	127.27	20.68	71.14	7.10	6.90	6.30	5.80	193.59	239.62	143.94	144.36	29.57	0.87	0.20	26.62
3/19/2014 12:28	127.27	20.71	71.13	7.10	6.90	6.30	5.80	193.60	239.74	143.84	144.31	29.51	0.93	0.20	26.41
3/19/2014 12:29	127.27	20.82	71.04	7.10	6.90	6.30	5.80	194.04	240.12	143.84	144.13	29.44	0.82	0.20	25.09

Time	CORRECTED REACTOR FEED MBPD 2SF3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/19/2014 12:30	127.27	20.82	70.93	7.10	6.90	6.30	5.80	194.20	240.32	143.84	144.07	29.49	0.80	0.20	25.38
3/19/2014 12:31	127.26	20.80	70.89	7.10	6.90	6.30	5.80	194.72	240.97	143.88	143.86	29.45	0.68	0.20	25.35
3/19/2014 12:32	127.26	20.78	70.75	7.10	6.90	6.30	5.80	195.01	241.32	143.98	143.87	29.43	0.63	0.20	21.78
3/19/2014 12:33															
Average	127.24	20.77	70.54	7.10	6.90	6.30	5.80	196.71	243.44	143.83	144.02	29.55	1.09	0.19	27.03

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/19/2014 13:27	127.28	20.93	70.07	7.10	6.90	6.30	5.80	194.90	241.19	144.27	144.26	29.33	1.16	0.20	37.67
3/19/2014 13:28	127.28	20.92	70.06	7.10	6.90	6.30	5.80	195.73	242.22	144.28	144.43	29.42	1.20	0.20	38.38
3/19/2014 13:29	127.28	20.88	70.26	7.10	6.90	6.30	5.80	195.15	241.50	144.27	144.47	29.45	1.47	0.20	38.13
3/19/2014 13:30	127.28	20.91	70.30	7.10	6.90	6.30	5.80	195.63	242.05	144.26	144.59	29.45	1.29	0.20	37.66
3/19/2014 13:31	127.27	21.02	70.40	7.10	6.90	6.30	5.80	195.59	241.93	144.26	144.62	29.46	1.18	0.20	38.86
3/19/2014 13:32	127.27	20.99	70.28	7.10	6.90	6.30	5.80	195.45	241.87	144.27	144.77	29.49	1.18	0.20	38.20
3/19/2014 13:33	127.26	20.89	70.09	7.10	6.90	6.30	5.80	196.05	242.61	144.28	144.98	29.51	1.14	0.20	36.75
3/19/2014 13:34	127.27	20.87	70.13	7.10	6.90	6.30	5.80	195.06	241.32	144.34	144.90	29.52	1.18	0.20	38.86
3/19/2014 13:35	127.29	20.80	70.31	7.10	6.90	6.30	5.80	195.01	241.13	144.33	144.64	29.55	1.29	0.20	37.78
3/19/2014 13:36	127.28	20.81	70.53	7.10	6.90	6.30	5.80	194.37	240.49	144.30	144.59	29.58	1.22	0.20	37.51
3/19/2014 13:37	127.27	20.86	70.56	7.10	6.90	6.30	5.80	194.50	240.57	144.32	144.44	29.57	1.15	0.20	36.46
3/19/2014 13:38	127.27	20.86	70.44	7.10	6.90	6.30	5.80	194.62	240.84	144.38	144.40	29.54	0.94	0.20	36.37
3/19/2014 13:39	127.27	20.89	70.40	7.10	6.90	6.30	5.80	194.72	240.97	144.32	144.24	29.52	1.12	0.20	37.78
3/19/2014 13:40	127.27	20.88	70.38	7.10	6.90	6.30	5.80	195.17	241.52	144.12	144.24	29.46	1.26	0.20	37.80
3/19/2014 13:41	127.27	20.84	70.32	7.10	6.90	6.30	5.80	195.24	241.60	144.15	144.25	29.43	1.15	0.20	37.45
3/19/2014 13:42	127.27	20.82	70.32	7.10	6.90	6.30	5.80	194.24	240.52	144.25	144.34	29.44	1.18	0.20	36.26
3/19/2014 13:43	127.29	20.77	70.32	7.10	6.90	6.30	5.80	193.74	240.18	144.27	144.64	29.47	1.07	0.20	37.60
3/19/2014 13:44	127.29	20.78	70.31	7.10	6.90	6.30	5.80	193.59	239.47	144.35	144.71	29.50	1.05	0.20	38.29
3/19/2014 13:45	127.29	20.84	70.26	7.10	6.90	6.30	5.80	194.40	241.01	144.34	144.93	29.49	0.90	0.20	36.91
3/19/2014 13:46	127.29	20.88	70.09	7.10	6.90	6.30	5.80	194.92	241.54	144.31	144.89	29.39	1.04	0.20	36.90
3/19/2014 13:47	127.28	21.02	70.12	7.10	6.90	6.30	5.80	195.09	241.60	144.31	144.77	29.41	1.14	0.20	36.88
3/19/2014 13:48	127.28	20.95	70.28	7.10	6.90	6.30	5.80	195.52	241.79	144.33	144.66	29.49	1.14	0.20	36.98
3/19/2014 13:49	127.28	20.71	70.50	7.10	6.90	6.30	5.80	194.90	241.53	144.32	144.31	29.57	1.19	0.20	37.71
3/19/2014 13:50	127.28	20.73	70.71	7.10	6.90	6.30	5.80	194.24	240.41	144.28	144.30	29.59	1.16	0.20	38.60
3/19/2014 13:51	127.28	20.77	70.67	7.10	6.90	6.30	5.80	194.31	239.64	144.29	144.28	29.55	1.06	0.20	36.73
3/19/2014 13:52	127.29	20.79	70.53	7.10	6.90	6.30	5.80	195.07	240.74	144.33	144.25	29.48	1.07	0.20	34.98
3/19/2014 13:53	127.31	20.86	70.43	7.10	6.90	6.30	5.80	195.57	242.27	144.30	144.15	29.44	1.10	0.20	36.37
3/19/2014 13:54	127.31	20.86	70.29	7.10	6.90	6.30	5.80	195.48	242.25	144.19	144.20	29.46	1.15	0.20	35.85
3/19/2014 13:55	127.31	20.85	70.32	7.10	6.90	6.30	5.80	195.42	241.78	144.19	144.38	29.41	1.25	0.20	36.89
3/19/2014 13:56	127.30	20.82	70.45	7.10	6.90	6.30	5.80	195.05	240.95	144.19	144.44	29.42	1.15	0.20	35.65
3/19/2014 13:57	127.29	20.70	70.68	7.10	6.90	6.30	5.80	195.24	242.02	144.20	144.61	29.63	1.02	0.20	35.21
3/19/2014 13:58	127.29	20.72	70.90	7.10	6.90	6.30	5.80	194.59	240.99	144.26	144.65	29.60	1.12	0.20	35.20
3/19/2014 13:59	127.27	20.76	70.70	7.10	6.90	6.30	5.80	194.82	240.44	144.25	144.78	29.55	1.12	0.20	35.49
3/19/2014 14:00	127.27	20.77	70.61	7.10	6.90	6.30	5.80	194.56	240.41	144.25	144.75	29.54	1.11	0.20	36.53
3/19/2014 14:01	127.29	20.81	70.58	7.10	6.90	6.30	5.80	194.74	240.63	144.28	144.64	29.45	1.17	0.20	36.26
3/19/2014 14:02	127.29	20.77	70.47	7.10	6.90	6.30	5.80	196.03	241.78	144.37	144.53	29.53	1.15	0.20	35.59
3/19/2014 14:03	127.28	20.67	70.56	7.10	6.90	6.30	5.80	196.02	241.72	144.34	144.18	29.60	1.19	0.20	36.47
3/19/2014 14:04	127.28	20.68	70.82	7.10	6.90	6.30	5.80	195.39	241.52	144.24	144.17	29.65	1.14	0.20	36.68
3/19/2014 14:05	127.29	20.71	70.79	7.10	6.90	6.30	5.80	195.21	241.61	144.23	144.14	29.63	1.13	0.20	35.66
3/19/2014 14:06	127.29	20.71	70.65	7.10	6.90	6.30	5.80	195.35	241.89	144.20	144.18	29.56	1.24	0.20	36.17
3/19/2014 14:07	127.29	20.68	70.62	7.10	6.90	6.30	5.80	194.79	241.56	144.19	144.29	29.54	1.26	0.20	36.16
3/19/2014 14:08	127.29	20.69	70.64	7.10	6.90	6.30	5.80	194.38	240.63	144.14	144.33	29.52	1.38	0.20	36.29
3/19/2014 14:09	127.28	20.71	70.61	7.10	6.90	6.30	5.80	194.77	240.89	144.14	144.47	29.61	1.38	0.20	37.22
3/19/2014 14:10	127.28	20.74	70.62	7.10	6.90	6.30	5.80	194.10	240.35	144.16	144.52	29.57	1.29	0.20	37.75
3/19/2014 14:11	127.30	20.85	70.42	7.10	6.90	6.30	5.80	193.84	240.29	144.20	144.67	29.54	1.17	0.20	36.21
3/19/2014 14:12	127.30	20.85	70.23	7.10	6.90	6.30	5.80	193.59	238.62	144.32	144.69	29.52	1.15	0.20	36.90
3/19/2014 14:13	127.28	20.85	70.14	7.10	6.90	6.30	5.80	193.35	238.86	144.32	144.76	29.46	1.21	0.20	35.05
3/19/2014 14:14	127.28	20.82	70.01	7.10	6.90	6.30	5.80	193.63	239.67	144.31	144.71	29.47	1.10	0.20	36.14
3/19/2014 14:15	127.28	20.75	70.03	7.10	6.90	6.30	5.80	194.44	239.55	144.30	144.49	29.49	1.13	0.20	34.92
3/19/2014 14:16	127.28	20.72	70.16	7.10	6.90	6.30	5.80	193.89	239.16	144.24	144.28	29.57	1.40	0.20	36.49
3/19/2014 14:17	127.28	20.62	70.37	7.10	6.90	6.30	5.80	192.74	238.75	144.28	144.31	29.63	1.40	0.20	37.52
3/19/2014 14:18	127.29	20.68	70.29	7.10	6.90	6.30	5.80	192.14	237.51	144.44	144.41	29.42	1.14	0.20	37.33
3/19/2014 14:19	127.29	20.89	70.00	7.10	6.90	6.30	5.80	192.18	237.56	144.41	144.39	29.30	1.04	0.20	36.53
3/19/2014 14:20	127.29	20.90	69.84	7.10	6.90	6.30	5.80	191.10	236.43	144.32	144.42	29.32	1.30	0.20	36.36
3/19/2014 14:21	127.29	20.94	69.75	7.10	6.90	6.30	5.80	190.63	236.37	144.39	144.71	29.40	1.00	0.20	37.31
3/19/2014 14:22	127.29	20.92	69.89	7.10	6.90	6.30	5.80	190.99	236.40	144.64	144.77	29.37	0.80	0.20	34.74
3/19/2014 14:23	127.29	20.86	69.93	7.10	6.90	6.30	5.80	191.69	237.17	144.65	144.96	29.38	0.75	0.20	32.12
3/19/2014 14:24	127.29	20.86	70.01	7.10	6.90	6.30	5.80	191.47	237.33	144.66	144.96	29.41	1.05	0.20	34.29
3/19/2014 14:25	127.29	20.83	70.32	7.10	6.90	6.30	5.80	191.44	237.53	144.62	144.94	29.44	1.09	0.20	36.51
3/19/2014 14:26	127.29	20.84	70.57	7.10	6.90	6.30	5.80	191.24	236.85	144.50	144.93	29.37	0.97	0.20	36.72
3/19/2014 14:27	127.28	20.88	70.63	7.10	6.90	6.30	5.80	192.17	237.73	144.52	144.89	29.36	0.87	0.20	33.59
3/19/2014 14:28	127.28	20.89	70.61	7.10	6.90	6.30	5.80	192.30	237.17	144.59	144.81	29.35	1.01	0.20	34.75
3/19/2014 14:29	127.29	20.90	70.61	7.10	6.90	6.30	5.80	191.97	237.93	144.59	144.56	29.42	1.20	0.20	34.21
3/19/2014 14:30	127.29	20.89	70.83	7.10	6.90	6.30	5.80	191.65	237.97	144.59	144.56	29.47	1.05	0.20	35.54
3/19/2014 14:31	127.29	20.87	70.83	7.10	6.90	6.30	5.80	191.64	237.93	144.58	144.57	29.40	0.83	0.20	32.96
3/19/2014 14:32	127.29	20.87	70.58	7.10	6.90	6.30	5.80	191.65	237.68	144.55	144.59	29.38	0.85	0.20	33.90
3/19/2014 14:33	127.29	20.86	70.50	7.10	6.90	6.30	5.80	192.10	239.08	144.54	144.65	29.33	0.80	0.20	34.35

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/19/2014 14:34	127.29	20.85	70.50	7.10	6.90	6.30	5.80	193.38	240.19	144.50	144.64	29.39	0.80	0.26	34.38
3/19/2014 14:35	127.30	20.79	70.72	7.10	6.90	6.30	5.80	193.55	239.85	144.48	144.62	29.41	0.82	0.42	34.72
3/19/2014 14:36	127.30	20.81	70.84	7.10	6.90	6.30	5.80	193.15	238.73	144.40	144.68	29.39	0.82	0.59	35.70
3/19/2014 14:37	127.31	20.90	71.11	7.10	6.90	6.30	5.80	192.84	238.55	144.43	144.89	29.40	0.88	1.12	36.25
3/19/2014 14:38	127.30	20.87	71.28	7.10	6.90	6.30	5.80	192.46	237.82	144.50	144.89	29.44	0.99	1.20	35.83
3/19/2014 14:39															
Average	127.29	20.83	70.42	7.10	6.90	6.30	5.80	193.97	240.04	144.34	144.56	29.48	1.11	0.23	36.34

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/19/2014 15:31	127.27	20.70	71.24	7.10	6.90	6.30	5.80	195.08	241.25	144.37	144.74	29.63	0.97	0.21	35.53
3/19/2014 15:32	127.27	20.74	71.05	7.10	6.90	6.30	5.80	195.42	242.11	144.36	144.66	29.56	0.97	0.25	34.98
3/19/2014 15:33	127.27	20.84	70.77	7.10	6.90	6.30	5.80	195.83	241.83	144.33	144.58	29.49	1.18	0.20	34.72
3/19/2014 15:34	127.27	20.83	70.72	7.10	6.90	6.30	5.80	194.64	240.89	144.35	144.33	29.53	1.23	0.20	36.05
3/19/2014 15:35	127.27	20.79	70.83	7.10	6.90	6.30	5.80	194.69	241.02	144.39	144.34	29.57	1.15	0.20	35.02
3/19/2014 15:36	127.26	20.76	70.83	7.10	6.90	6.30	5.80	194.70	241.42	144.37	144.39	29.59	1.12	0.20	34.86
3/19/2014 15:37	127.26	20.67	70.85	7.10	6.90	6.30	5.80	194.10	241.34	144.29	144.38	29.60	1.20	0.20	35.24
3/19/2014 15:38	127.23	20.70	70.90	7.10	6.90	6.30	5.80	194.24	241.08	144.30	144.35	29.62	1.20	0.20	38.03
3/19/2014 15:39	127.22	20.80	70.88	7.10	6.90	6.30	5.80	194.58	241.09	144.31	144.41	29.62	1.13	0.20	37.45
3/19/2014 15:40	127.22	20.79	70.81	7.10	6.90	6.30	5.80	194.33	241.11	144.32	144.63	29.61	1.27	0.20	36.77
3/19/2014 15:41	127.22	20.75	70.71	7.10	6.90	6.30	5.80	194.99	241.15	144.36	144.67	29.57	1.13	0.20	34.98
3/19/2014 15:42	127.23	20.76	70.62	7.10	6.90	6.30	5.80	194.79	241.07	144.36	144.81	29.57	1.23	0.20	36.69
3/19/2014 15:43	127.24	20.77	70.66	7.10	6.90	6.30	5.80	194.24	240.25	144.39	144.82	29.58	1.14	0.20	36.14
3/19/2014 15:44	127.26	20.76	70.67	7.10	6.90	6.30	5.80	194.91	240.48	144.36	144.88	29.62	1.13	0.20	34.56
3/19/2014 15:45	127.26	20.73	70.67	7.10	6.90	6.30	5.80	195.14	241.23	144.26	144.76	29.62	1.20	0.20	34.98
3/19/2014 15:46	127.26	20.72	70.59	7.10	6.90	6.30	5.80	195.15	241.34	144.25	144.40	29.59	1.19	0.20	34.70
3/19/2014 15:47	127.26	20.70	70.56	7.10	6.90	6.30	5.80	195.54	241.72	144.20	144.36	29.57	1.15	0.20	36.75
3/19/2014 15:48	127.26	20.71	70.49	7.10	6.90	6.30	5.80	194.76	241.63	144.20	144.23	29.54	1.12	0.20	34.52
3/19/2014 15:49	127.27	20.74	70.64	7.10	6.90	6.30	5.80	194.17	240.93	144.23	144.27	29.64	1.18	0.20	36.94
3/19/2014 15:50	127.27	20.74	70.80	7.10	6.90	6.30	5.80	193.54	239.92	144.26	144.40	29.65	0.97	0.20	35.86
3/19/2014 15:51	127.27	20.72	70.78	7.10	6.90	6.30	5.80	194.73	241.32	144.36	144.42	29.63	1.10	0.20	34.30
3/19/2014 15:52	127.27	20.72	70.73	7.10	6.90	6.30	5.80	194.46	240.55	144.35	144.49	29.58	1.25	0.20	35.24
3/19/2014 15:53	127.27	20.72	70.76	7.10	6.90	6.30	5.80	194.68	240.49	144.32	144.56	29.68	1.19	0.20	36.39
3/19/2014 15:54	127.25	20.71	70.87	7.10	6.90	6.30	5.80	193.65	240.06	144.33	144.79	29.63	1.21	0.20	35.11
3/19/2014 15:55	127.25	20.69	70.92	7.10	6.90	6.30	5.80	193.18	239.09	144.38	144.83	29.65	1.03	0.20	34.18
3/19/2014 15:56	127.25	20.71	70.90	7.10	6.90	6.30	5.80	192.91	239.31	144.40	144.99	29.57	0.92	0.20	34.85
3/19/2014 15:57	127.25	20.79	70.81	7.10	6.90	6.30	5.80	194.12	240.22	144.49	144.93	29.53	0.85	0.20	35.00
3/19/2014 15:58	127.27	20.80	70.68	7.10	6.90	6.30	5.80	195.10	240.93	144.48	144.63	29.51	0.94	0.20	33.76
3/19/2014 15:59	127.27	20.85	70.51	7.10	6.90	6.30	5.80	194.92	241.13	144.45	144.41	29.43	0.96	0.20	35.02
3/19/2014 16:00	127.28	20.87	70.47	7.10	6.90	6.30	5.80	195.24	241.58	144.41	144.39	29.35	1.06	0.20	35.29
3/19/2014 16:01	127.28	20.92	70.55	7.10	6.90	6.30	5.80	194.48	240.57	144.24	144.32	29.43	1.15	0.20	35.78
3/19/2014 16:02	127.29	20.93	70.86	7.10	6.90	6.30	5.80	194.45	240.23	144.29	144.34	29.50	1.24	0.20	34.03
3/19/2014 16:03	127.28	20.88	70.92	7.10	6.90	6.30	5.80	195.10	241.35	144.46	144.42	29.45	1.10	0.20	34.23
3/19/2014 16:04	127.27	20.68	70.83	7.10	6.90	6.30	5.80	195.15	240.72	144.41	144.44	29.52	1.06	0.20	34.73
3/19/2014 16:05	127.27	20.70	70.83	7.10	6.90	6.30	5.80	194.51	240.82	144.24	144.52	29.53	1.24	0.20	34.30
3/19/2014 16:06	127.27	20.78	70.88	7.10	6.90	6.30	5.80	193.99	240.71	144.29	144.58	29.64	1.19	0.20	34.76
3/19/2014 16:07	127.27	20.78	71.02	7.10	6.90	6.30	5.80	193.40	239.38	144.45	144.76	29.63	0.99	0.20	34.34
3/19/2014 16:08	127.26	20.79	71.04	7.10	6.90	6.30	5.80	193.74	240.06	144.45	144.79	29.58	0.88	0.20	33.35
3/19/2014 16:09	127.26	20.78	70.89	7.10	6.90	6.30	5.80	193.48	239.76	144.48	144.88	29.56	1.01	0.20	34.83
3/19/2014 16:10	127.27	20.76	70.83	7.10	6.90	6.30	5.80	194.07	240.41	144.46	144.83	29.58	1.04	0.20	34.71
3/19/2014 16:11	127.27	20.79	70.79	7.10	6.90	6.30	5.80	194.20	240.59	144.40	144.65	29.49	0.99	0.20	33.15
3/19/2014 16:12	127.27	20.89	70.67	7.10	6.90	6.30	5.80	193.26	239.41	144.39	144.58	29.41	0.96	0.20	33.74
3/19/2014 16:13	127.27	20.86	70.80	7.10	6.90	6.30	5.80	192.69	239.43	144.34	144.32	29.43	1.08	0.20	33.73
3/19/2014 16:14	127.26	20.77	70.87	7.10	6.90	6.30	5.80	194.52	241.09	144.38	144.35	29.50	0.86	0.20	33.71
3/19/2014 16:15	127.26	20.75	70.78	7.10	6.90	6.30	5.80	194.92	241.04	144.49	144.47	29.47	0.94	0.20	34.07
3/19/2014 16:16	127.26	20.68	70.97	7.10	6.90	6.30	5.80	194.80	240.85	144.45	144.46	29.53	1.26	0.20	35.56
3/19/2014 16:17	127.26	20.70	71.10	7.10	6.90	6.30	5.80	195.07	241.02	144.30	144.42	29.53	1.05	0.20	35.85
3/19/2014 16:18	127.25	20.79	71.14	7.10	6.90	6.30	5.80	195.13	241.40	144.28	144.44	29.53	0.97	0.20	35.10
3/19/2014 16:19	127.25	20.82	71.12	7.10	6.90	6.30	5.80	194.56	240.97	144.22	144.51	29.54	1.10	0.19	35.79
3/19/2014 16:20	127.26	20.84	71.07	7.10	6.90	6.30	5.80	195.31	241.48	144.18	144.51	29.52	1.15	0.19	35.38
3/19/2014 16:21	127.26	20.58	71.07	7.10	6.90	6.30	5.80	195.44	241.59	144.04	144.50	29.57	1.21	0.20	34.36
3/19/2014 16:22	127.26	20.63	71.22	7.10	6.90	6.30	5.80	195.71	241.94	144.05	144.48	29.63	1.22	0.20	35.73
3/19/2014 16:23	127.26	20.81	71.26	7.10	6.90	6.30	5.80	195.00	241.41	144.10	144.43	29.68	1.11	0.20	35.21
3/19/2014 16:24	127.26	20.76	71.39	7.10	6.90	6.30	5.80	194.21	239.65	144.11	144.38	29.76	1.09	0.20	34.76
3/19/2014 16:25	127.26	20.61	71.35	7.10	6.90	6.30	5.80	193.65	239.64	144.17	144.20	29.74	0.94	0.20	33.38
3/19/2014 16:26	127.27	20.65	71.15	7.10	6.90	6.30	5.80	194.37	240.18	144.15	144.17	29.64	0.97	0.20	33.53
3/19/2014 16:27	127.26	20.78	70.84	7.10	6.90	6.30	5.80	194.75	241.93	144.08	144.07	29.55	0.84	0.20	32.65
3/19/2014 16:28	127.25	20.81	70.72	7.10	6.90	6.30	5.80	194.89	241.70	144.08	144.09	29.57	1.00	0.20	33.09
3/19/2014 16:29	127.26	20.90	70.75	7.10	6.90	6.30	5.80	194.92	242.38	144.06	144.14	29.52	1.04	0.20	34.67
3/19/2014 16:30	127.26	20.85	70.94	7.10	6.90	6.30	5.80	195.20	241.41	144.05	144.18	29.62	1.09	0.20	34.88
3/19/2014 16:31	127.26	20.71	71.27	7.10	6.90	6.30	5.80	194.68	240.42	144.02	144.31	29.67	1.25	0.20	35.85
3/19/2014 16:32	127.26	20.73	71.34	7.10	6.90	6.30	5.80	194.76	240.59	144.03	144.34	29.63	1.15	0.20	36.54
3/19/2014 16:33	127.26	20.80	71.30	7.10	6.90	6.30	5.80	194.69	241.14	144.06	144.45	29.62	1.17	0.20	36.04
3/19/2014 16:34	127.26	20.80	71.12	7.10	6.90	6.30	5.80	195.01	241.26	144.05	144.45	29.59	1.18	0.40	36.01
3/19/2014 16:35	127.26	20.79	70.93	7.10	6.90	6.30	5.80	195.34	241.89	144.05	144.48	29.56	1.20	1.21	35.71
3/19/2014 16:36	127.27	20.79	70.71	7.10	6.90	6.30	5.80	195.89	242.41	144.01	144.38	29.49	1.17	1.54	35.47
3/19/2014 16:37	127.27	20.79	70.63	7.10	6.90	6.30	5.80	195.20	241.24	143.87	144.01	29.52	1.20	1.16	36.95

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Air1ot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/19/2014 16:38	127.26	20.81	70.71	7.10	6.90	6.30	5.80	195.02	241.43	143.90	143.99	29.54	1.43	1.21	37.94
3/19/2014 16:39	127.26	20.89	70.70	7.10	6.90	6.30	5.80	195.07	241.80	143.97	143.95	29.51	1.20	1.37	37.97
3/19/2014 16:40	127.26	20.85	70.66	7.10	6.90	6.30	5.80	195.09	240.89	143.98	143.93	29.53	1.10	1.44	37.81
3/19/2014 16:41	127.26	20.70	70.74	7.10	6.90	6.30	5.80	194.51	240.89	144.01	143.88	29.63	1.28	1.82	37.43
3/19/2014 16:42															
Average	127.26	20.77	70.87	7.10	6.90	6.30	5.80	194.62	240.91	144.26	144.45	29.57	1.10	0.32	35.23

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25AirTot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/20/14 9:07	127.07	21.60	70.35	6.00	5.80	4.90	5.50	198.76	245.76	143.11	143.27	29.76	1.53	0.35	29.61
3/20/14 9:08	127.07	21.64	70.62	6.00	5.80	4.90	5.50	198.48	245.40	143.10	143.23	29.75	1.48	0.22	32.03
3/20/14 9:09	127.06	21.75	70.56	6.00	5.80	4.90	5.50	197.82	244.76	143.10	143.09	29.72	1.37	0.22	30.85
3/20/14 9:10	127.06	21.75	70.38	6.00	5.80	4.90	5.50	198.28	245.81	143.11	143.11	29.70	1.24	0.25	30.77
3/20/14 9:11	127.06	21.77	70.31	6.00	5.80	4.90	5.50	197.93	244.96	143.17	143.16	29.65	1.19	0.36	30.34
3/20/14 9:12	127.06	21.79	70.04	6.00	5.80	4.90	5.50	197.86	245.30	143.35	143.18	29.60	1.23	0.26	30.11
3/20/14 9:13	127.07	21.83	69.92	6.00	5.80	4.90	5.50	198.03	245.53	143.31	143.25	29.61	1.36	0.39	31.33
3/20/14 9:14	127.07	21.81	70.01	6.00	5.80	4.90	5.50	197.87	245.47	143.15	143.26	29.65	1.67	0.35	31.65
3/20/14 9:15	127.07	21.76	70.19	6.00	5.80	4.90	5.50	197.68	245.10	143.16	143.27	29.70	1.51	0.20	31.79
3/20/14 9:16	127.07	21.74	70.33	6.00	5.80	4.90	5.50	197.56	244.43	143.18	143.32	29.73	1.43	0.21	29.72
3/20/14 9:17	127.07	21.70	70.23	6.00	5.80	4.90	5.50	197.85	244.55	143.22	143.50	29.67	1.25	0.23	29.91
3/20/14 9:18	127.07	21.73	69.81	6.00	5.80	4.90	5.50	198.25	244.96	143.35	143.51	29.54	1.00	0.23	27.90
3/20/14 9:19	127.06	21.82	69.55	6.00	5.80	4.90	5.50	198.72	245.08	143.29	143.57	29.50	1.15	0.25	29.48
3/20/14 9:20	127.06	21.86	69.59	6.00	5.80	4.90	5.50	198.60	245.45	143.10	143.53	29.57	1.30	0.34	30.28
3/20/14 9:21	127.06	21.91	69.91	6.00	5.80	4.90	5.50	198.54	245.28	143.12	143.41	29.63	1.28	0.24	30.10
3/20/14 9:22	127.07	21.72	70.20	6.00	5.80	4.90	5.50	198.05	244.75	143.18	143.44	29.64	1.17	0.30	29.54
3/20/14 9:23	127.07	21.71	70.38	6.00	5.80	4.90	5.50	197.41	244.82	143.19	143.52	29.67	1.20	0.49	29.66
3/20/14 9:24	127.07	21.70	70.42	6.00	5.80	4.90	5.50	198.13	245.05	143.21	143.49	29.67	1.23	0.57	29.53
3/20/14 9:25	127.07	21.75	70.22	6.00	5.80	4.90	5.50	198.59	245.20	143.20	143.40	29.51	1.02	0.58	28.07
3/20/14 9:26	127.07	21.89	70.02	6.00	5.80	4.90	5.50	199.17	245.78	143.14	143.31	29.48	1.11	0.35	28.21
3/20/14 9:27	127.08	21.87	69.90	6.00	5.80	4.90	5.50	198.77	246.04	143.09	143.04	29.50	1.14	0.29	28.64
3/20/14 9:28	127.08	21.80	70.05	6.00	5.80	4.90	5.50	198.57	245.48	142.92	143.07	29.55	1.28	0.31	28.44
3/20/14 9:29	127.07	21.81	70.21	6.00	5.80	4.90	5.50	198.21	245.64	142.98	143.14	29.52	1.15	0.21	27.40
3/20/14 9:30	127.07	21.82	70.17	6.00	5.80	4.90	5.50	198.92	246.14	143.15	143.22	29.49	1.02	0.21	26.45
3/20/14 9:31	127.07	21.81	70.16	6.00	5.80	4.90	5.50	198.89	246.16	143.14	143.49	29.50	1.01	0.20	27.71
3/20/14 9:32	127.07	21.79	70.15	6.00	5.80	4.90	5.50	199.06	246.24	143.10	143.49	29.52	1.05	0.20	27.79
3/20/14 9:33	127.07	21.78	70.32	6.00	5.80	4.90	5.50	199.00	246.20	143.12	143.51	29.55	1.04	0.20	27.20
3/20/14 9:34	127.08	21.76	70.58	6.00	5.80	4.90	5.50	198.91	246.08	143.18	143.54	29.64	1.12	0.20	28.83
3/20/14 9:35	127.08	21.79	70.80	6.00	5.80	4.90	5.50	199.13	246.25	143.19	143.62	29.67	1.12	0.20	28.66
3/20/14 9:36	127.08	21.88	70.89	6.00	5.80	4.90	5.50	198.89	246.57	143.21	143.62	29.60	1.11	0.20	28.13
3/20/14 9:37	127.08	21.90	70.83	6.00	5.80	4.90	5.50	198.82	246.19	143.22	143.64	29.53	0.98	0.20	27.85
3/20/14 9:38	127.07	21.94	70.62	6.00	5.80	4.90	5.50	199.15	246.67	143.24	143.61	29.53	1.07	0.20	27.52
3/20/14 9:39	127.07	21.90	70.56	6.00	5.80	4.90	5.50	199.95	247.18	143.20	143.51	29.57	1.21	0.20	28.71
3/20/14 9:40	127.07	21.78	70.82	6.00	5.80	4.90	5.50	200.88	248.73	143.07	143.45	29.70	1.36	0.21	27.68
3/20/14 9:41	127.08	21.74	70.92	6.00	5.80	4.90	5.50	200.00	248.28	142.98	143.18	29.76	1.47	0.21	27.78
3/20/14 9:42	127.08	21.64	71.06	6.00	5.80	4.90	5.50	199.44	246.68	142.71	142.84	29.89	1.87	0.21	28.27
3/20/14 9:43	127.08	21.63	71.24	6.00	5.80	4.90	5.50	198.87	245.82	142.81	142.90	29.93	1.64	0.20	29.07
3/20/14 9:44	127.08	21.62	71.15	6.00	5.80	4.90	5.50	199.31	246.00	143.12	143.12	29.85	1.22	0.21	28.84
3/20/14 9:45	127.08	21.64	70.75	6.00	5.80	4.90	5.50	199.44	246.54	143.11	143.33	29.81	1.05	0.21	27.57
3/20/14 9:46	127.08	21.68	70.23	6.00	5.80	4.90	5.50	199.15	246.21	143.10	143.34	29.73	1.20	0.21	29.44
3/20/14 9:47	127.07	21.71	69.94	6.00	5.80	4.90	5.50	198.61	245.68	143.14	143.37	29.63	1.21	0.21	29.12
3/20/14 9:48	127.07	21.80	69.89	6.00	5.80	4.90	5.50	199.75	247.37	143.26	143.39	29.57	1.28	0.21	28.16
3/20/14 9:49	127.08	21.80	69.94	6.00	5.80	4.90	5.50	199.71	247.17	143.25	143.47	29.57	1.40	0.20	27.86
3/20/14 9:50	127.08	21.80	69.97	6.00	5.80	4.90	5.50	199.46	246.50	143.21	143.47	29.59	1.46	0.20	27.25
3/20/14 9:51	127.07	21.78	70.10	6.00	5.80	4.90	5.50	199.05	246.39	143.20	143.49	29.68	1.52	0.20	28.58
3/20/14 9:52	127.07	21.70	70.21	6.00	5.80	4.90	5.50	199.16	245.92	143.16	143.50	29.71	1.52	0.20	28.15
3/20/14 9:53	127.08	21.73	70.16	6.00	5.80	4.90	5.50	199.03	245.71	143.19	143.53	29.69	1.38	0.20	27.14
3/20/14 9:54	127.08	21.80	69.92	6.00	5.80	4.90	5.50	199.21	246.77	143.28	143.55	29.62	1.40	0.20	28.03
3/20/14 9:55	127.07	21.78	69.68	6.00	5.80	4.90	5.50	199.61	247.40	143.24	143.62	29.60	1.22	0.20	28.08
3/20/14 9:56	127.08	21.71	69.66	6.00	5.80	4.90	5.50	198.91	245.98	143.13	143.58	29.62	1.38	0.20	27.99
3/20/14 9:57	127.08	21.71	69.79	6.00	5.80	4.90	5.50	198.29	245.83	143.13	143.47	29.69	1.33	0.20	26.96
3/20/14 9:58	127.08	21.69	69.95	6.00	5.80	4.90	5.50	198.33	245.38	143.15	143.43	29.70	1.36	0.20	26.05
3/20/14 9:59	127.09	21.71	70.06	6.00	5.80	4.90	5.50	198.36	245.08	143.24	143.30	29.71	1.39	0.20	26.39
3/20/14 10:00	127.09	21.79	69.98	6.00	5.80	4.90	5.50	198.03	244.43	143.50	143.31	29.67	1.44	0.20	27.75
3/20/14 10:01	127.09	21.79	69.94	6.00	5.80	4.90	5.50	197.86	245.18	143.55	143.43	29.66	1.32	0.20	28.27
3/20/14 10:02	127.09	21.79	69.88	6.00	5.80	4.90	5.50	198.39	245.19	143.71	143.65	29.66	1.21	0.20	26.98
3/20/14 10:03	127.08	21.82	69.99	6.00	5.80	4.90	5.50	197.87	244.62	143.67	143.70	29.73	1.33	0.20	26.98
3/20/14 10:04	127.08	21.91	69.95	6.00	5.80	4.90	5.50	196.67	242.76	143.64	143.85	29.60	1.25	0.20	26.68
3/20/14 10:05	127.09	21.90	69.82	6.00	5.80	4.90	5.50	196.88	242.97	143.85	143.90	29.51	1.02	0.20	26.55
3/20/14 10:06	127.09	21.85	69.75	6.00	5.80	4.90	5.50	197.22	243.98	143.88	144.11	29.48	1.22	0.21	28.75
3/20/14 10:07	127.09	21.85	69.70	6.00	5.80	4.90	5.50	197.69	245.15	143.98	144.32	29.40	1.19	0.21	27.52
3/20/14 10:08	127.09	21.87	69.76	6.00	5.80	4.90	5.50	197.57	245.27	143.97	144.32	29.48	1.34	0.21	27.80
3/20/14 10:09	127.09	21.88	69.98	6.00	5.80	4.90	5.50	197.99	245.52	143.94	144.30	29.55	1.25	0.20	28.74
3/20/14 10:10	127.09	21.94	70.10	6.00	5.80	4.90	5.50	197.63	245.04	143.92	144.28	29.46	1.30	0.20	28.40
3/20/14 10:11	127.08	21.91	70.14	6.00	5.80	4.90	5.50	197.76	245.18	143.85	144.22	29.39	1.45	0.20	27.22
3/20/14 10:12	127.08	21.81	70.02	6.00	5.80	4.90	5.50	198.33	245.36	143.85	144.21	29.57	1.37	0.20	26.69
3/20/14 10:13	127.10	21.81	70.13	6.00	5.80	4.90	5.50	197.77	244.54	143.84	144.19	29.63	1.19	0.20	27.09

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/20/14 10:14	127.10	21.80	70.26	6.00	5.80	4.90	5.50	197.80	244.60	143.85	144.19	29.67	1.28	0.20	28.29
3/20/14 10:15	127.10	21.82	70.28	6.00	5.80	4.90	5.50	197.98	244.93	143.89	144.20	29.70	1.13	0.20	27.95
3/20/14 10:16	127.10	21.87	70.19	6.00	5.80	4.90	5.50	198.22	245.17	143.93	144.16	29.70	1.06	0.20	26.65
3/20/14 10:17	127.10	21.89	70.20	6.00	5.80	4.90	5.50	198.14	244.76	144.07	144.02	29.67	0.99	0.20	25.96
3/20/14 10:18															
Average	127.08	21.79	70.19	6.00	5.80	4.90	5.50	198.51	245.61	143.32	143.54	29.63	1.27	0.24	28.41

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532I	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.ur	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/20/2014 9:31	127.07	21.81	70.16	6.00	5.80	4.90	5.50	198.89	246.16	143.14	143.49	29.50	1.01	0.20	27.71
3/20/2014 9:32	127.07	21.79	70.15	6.00	5.80	4.90	5.50	199.06	246.24	143.10	143.49	29.52	1.05	0.20	27.79
3/20/2014 9:33	127.07	21.78	70.32	6.00	5.80	4.90	5.50	199.00	246.20	143.12	143.51	29.55	1.04	0.20	27.20
3/20/2014 9:34	127.08	21.76	70.58	6.00	5.80	4.90	5.50	198.91	246.08	143.18	143.54	29.64	1.12	0.20	28.83
3/20/2014 9:35	127.08	21.79	70.80	6.00	5.80	4.90	5.50	199.13	246.25	143.19	143.62	29.67	1.12	0.20	28.66
3/20/2014 9:36	127.08	21.88	70.89	6.00	5.80	4.90	5.50	198.89	246.57	143.21	143.62	29.60	1.11	0.20	28.13
3/20/2014 9:37	127.08	21.90	70.83	6.00	5.80	4.90	5.50	198.82	246.19	143.22	143.64	29.53	0.98	0.20	27.85
3/20/2014 9:38	127.07	21.94	70.62	6.00	5.80	4.90	5.50	199.15	246.67	143.24	143.61	29.53	1.07	0.20	27.52
3/20/2014 9:39	127.07	21.90	70.56	6.00	5.80	4.90	5.50	199.95	247.18	143.20	143.51	29.57	1.21	0.20	28.71
3/20/2014 9:40	127.07	21.78	70.82	6.00	5.80	4.90	5.50	200.88	248.73	143.07	143.45	29.70	1.36	0.21	27.68
3/20/2014 9:41	127.08	21.74	70.92	6.00	5.80	4.90	5.50	200.00	248.28	142.98	143.18	29.76	1.47	0.21	27.78
3/20/2014 9:42	127.08	21.64	71.06	6.00	5.80	4.90	5.50	199.44	246.68	142.71	142.84	29.89	1.87	0.21	28.27
3/20/2014 9:43	127.08	21.63	71.24	6.00	5.80	4.90	5.50	198.87	245.82	142.81	142.90	29.93	1.64	0.20	29.07
3/20/2014 9:44	127.08	21.62	71.15	6.00	5.80	4.90	5.50	199.31	246.00	143.12	143.12	29.85	1.22	0.21	28.84
3/20/2014 9:45	127.08	21.64	70.75	6.00	5.80	4.90	5.50	199.44	246.54	143.11	143.33	29.81	1.05	0.21	27.57
3/20/2014 9:46	127.08	21.68	70.23	6.00	5.80	4.90	5.50	199.15	246.21	143.10	143.34	29.73	1.20	0.21	29.44
3/20/2014 9:47	127.07	21.71	69.94	6.00	5.80	4.90	5.50	198.61	245.68	143.14	143.37	29.63	1.21	0.21	29.12
3/20/2014 9:48	127.07	21.80	69.89	6.00	5.80	4.90	5.50	199.75	247.37	143.26	143.39	29.57	1.28	0.21	28.16
3/20/2014 9:49	127.08	21.80	69.94	6.00	5.80	4.90	5.50	199.71	247.17	143.25	143.47	29.57	1.40	0.20	27.86
3/20/2014 9:50	127.08	21.80	69.97	6.00	5.80	4.90	5.50	199.46	246.50	143.21	143.47	29.59	1.46	0.20	27.25
3/20/2014 9:51	127.07	21.78	70.10	6.00	5.80	4.90	5.50	199.05	246.39	143.20	143.49	29.68	1.52	0.20	28.58
3/20/2014 9:52	127.07	21.70	70.21	6.00	5.80	4.90	5.50	199.16	245.92	143.16	143.50	29.71	1.52	0.20	28.15
3/20/2014 9:53	127.08	21.73	70.16	6.00	5.80	4.90	5.50	199.03	245.71	143.19	143.53	29.69	1.38	0.20	27.14
3/20/2014 9:54	127.08	21.80	69.92	6.00	5.80	4.90	5.50	199.21	246.77	143.28	143.55	29.62	1.40	0.20	28.03
3/20/2014 9:55	127.07	21.78	69.68	6.00	5.80	4.90	5.50	199.61	247.40	143.24	143.62	29.60	1.22	0.20	28.08
3/20/2014 9:56	127.08	21.71	69.66	6.00	5.80	4.90	5.50	198.91	245.98	143.13	143.58	29.62	1.38	0.20	27.99
3/20/2014 9:57	127.08	21.71	69.79	6.00	5.80	4.90	5.50	198.29	245.83	143.13	143.47	29.69	1.33	0.20	26.96
3/20/2014 9:58	127.08	21.69	69.95	6.00	5.80	4.90	5.50	198.33	245.38	143.15	143.43	29.70	1.36	0.20	26.05
3/20/2014 9:59	127.09	21.71	70.06	6.00	5.80	4.90	5.50	198.36	245.08	143.24	143.30	29.71	1.39	0.20	26.39
3/20/2014 10:00	127.09	21.79	69.98	6.00	5.80	4.90	5.50	198.03	244.43	143.50	143.31	29.67	1.44	0.20	27.75
3/20/2014 10:01	127.09	21.79	69.94	6.00	5.80	4.90	5.50	197.86	245.18	143.55	143.43	29.66	1.32	0.20	28.27
3/20/2014 10:02	127.09	21.79	69.88	6.00	5.80	4.90	5.50	198.39	245.19	143.71	143.65	29.66	1.21	0.20	26.98
3/20/2014 10:03	127.08	21.82	69.99	6.00	5.80	4.90	5.50	197.87	244.62	143.67	143.70	29.73	1.33	0.20	26.98
3/20/2014 10:04	127.08	21.91	69.95	6.00	5.80	4.90	5.50	196.67	242.76	143.64	143.85	29.60	1.25	0.20	26.68
3/20/2014 10:05	127.09	21.90	69.82	6.00	5.80	4.90	5.50	196.88	242.97	143.85	143.90	29.51	1.02	0.20	26.55
3/20/2014 10:06	127.09	21.85	69.75	6.00	5.80	4.90	5.50	197.22	243.98	143.88	144.11	29.48	1.22	0.21	28.75
3/20/2014 10:07	127.09	21.85	69.70	6.00	5.80	4.90	5.50	197.69	245.15	143.98	144.32	29.40	1.19	0.21	27.52
3/20/2014 10:08	127.09	21.87	69.76	6.00	5.80	4.90	5.50	197.57	245.27	143.97	144.32	29.48	1.34	0.21	27.80
3/20/2014 10:09	127.09	21.88	69.98	6.00	5.80	4.90	5.50	197.99	245.52	143.94	144.30	29.55	1.25	0.20	28.74
3/20/2014 10:10	127.09	21.94	70.10	6.00	5.80	4.90	5.50	197.63	245.04	143.92	144.28	29.46	1.30	0.20	28.40
3/20/2014 10:11	127.08	21.91	70.14	6.00	5.80	4.90	5.50	197.76	245.18	143.85	144.22	29.39	1.45	0.20	27.22
3/20/2014 10:12	127.08	21.81	70.02	6.00	5.80	4.90	5.50	198.33	245.36	143.85	144.21	29.57	1.37	0.20	26.69
3/20/2014 10:13	127.10	21.81	70.13	6.00	5.80	4.90	5.50	197.77	244.54	143.84	144.19	29.63	1.19	0.20	27.09
3/20/2014 10:14	127.10	21.80	70.26	6.00	5.80	4.90	5.50	197.80	244.60	143.85	144.19	29.67	1.28	0.20	28.29
3/20/2014 10:15	127.10	21.82	70.28	6.00	5.80	4.90	5.50	197.98	244.93	143.89	144.20	29.70	1.13	0.20	27.95
3/20/2014 10:16	127.10	21.87	70.19	6.00	5.80	4.90	5.50	198.22	245.17	143.93	144.16	29.70	1.06	0.20	26.65
3/20/2014 10:17	127.10	21.89	70.20	6.00	5.80	4.90	5.50	198.14	244.76	144.07	144.02	29.67	0.99	0.20	25.96
3/20/2014 10:18	127.10	21.95	70.22	6.00	5.80	4.90	5.50	198.82	245.46	144.05	144.00	29.57	0.93	0.20	26.03
3/20/2014 10:19	127.10	21.90	70.22	6.00	5.80	4.90	5.50	198.54	245.43	144.01	143.92	29.62	0.98	0.20	25.17
3/20/2014 10:20	127.10	21.76	70.43	6.00	5.80	4.90	5.50	198.10	245.35	143.96	143.92	29.67	1.47	0.20	27.11
3/20/2014 10:21	127.10	21.76	70.67	6.00	5.80	4.90	5.50	198.04	245.20	143.83	143.91	29.66	1.35	0.20	29.06
3/20/2014 10:22	127.10	21.76	70.87	6.00	5.80	4.90	5.50	197.76	244.73	143.85	144.00	29.70	1.18	0.20	28.63
3/20/2014 10:23	127.10	21.74	70.89	6.00	5.80	4.90	5.50	197.69	244.93	143.94	144.26	29.64	1.23	0.20	27.33
3/20/2014 10:24	127.10	21.70	70.52	6.00	5.80	4.90	5.50	198.35	245.80	143.93	144.28	29.53	1.03	0.20	26.79
3/20/2014 10:25	127.11	21.70	70.16	6.00	5.80	4.90	5.50	198.54	246.42	143.93	144.33	29.51	1.06	0.20	25.87
3/20/2014 10:26	127.11	21.72	70.17	6.00	5.80	4.90	5.50	198.28	245.99	143.88	144.29	29.57	1.43	0.20	27.56
3/20/2014 10:27	127.09	21.73	70.37	6.00	5.80	4.90	5.50	198.40	246.00	143.73	144.14	29.63	1.55	0.20	26.77
3/20/2014 10:28	127.09	21.76	70.45	6.00	5.80	4.90	5.50	199.03	246.33	143.70	144.11	29.63	1.47	0.20	27.78
3/20/2014 10:29	127.10	21.74	70.47	6.00	5.80	4.90	5.50	199.51	246.89	143.60	144.03	29.66	1.40	0.20	27.75
3/20/2014 10:30	127.10	21.69	70.53	6.00	5.80	4.90	5.50	198.44	245.53	143.61	144.06	29.74	1.49	0.20	27.68
3/20/2014 10:31	127.10	21.71	70.45	6.00	5.80	4.90	5.50	197.67	244.88	143.65	144.16	29.75	1.57	0.20	27.42
3/20/2014 10:32	127.10	21.78	70.22	6.00	5.80	4.90	5.50	197.88	244.88	143.71	144.18	29.65	1.33	0.20	26.62
3/20/2014 10:33	127.11	21.79	70.03	6.00	5.80	4.90	5.50	198.24	245.06	143.92	144.26	29.60	1.13	0.21	26.60
3/20/2014 10:34	127.11	21.85	69.80	6.00	5.80	4.90	5.50	198.35	245.38	143.87	144.16	29.56	1.19	0.21	26.74
3/20/2014 10:35	127.10	21.82	69.62	6.00	5.80	4.90	5.50	197.95	245.07	143.74	143.87	29.55	1.37	0.20	27.46
3/20/2014 10:36	127.10	21.75	69.82	6.00	5.80	4.90	5.50	198.08	245.28	143.72	143.77	29.70	1.36	0.20	27.92
3/20/2014 10:37	127.11	21.73	70.26	6.00	5.80	4.90	5.50	197.58	243.66	143.67	143.46	29.77	1.36	0.20	29.44

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/20/2014 10:38	127.11	21.66	70.55	6.00	5.80	4.90	5.50	196.98	243.58	143.71	143.54	29.76	1.21	0.40	29.49
3/20/2014 10:39	127.10	21.70	70.53	6.00	5.80	4.90	5.50	196.64	243.64	143.84	143.86	29.74	1.10	1.04	29.40
3/20/2014 10:40	127.10	21.83	70.37	6.00	5.80	4.90	5.50	197.20	244.49	143.90	144.13	29.69	0.86	1.21	27.91
3/20/2014 10:41	127.11	21.85	70.07	6.00	5.80	4.90	5.50	197.46	244.64	144.08	144.14	29.52	0.79	1.43	26.19
3/20/2014 10:42	127.11	21.92	69.91	6.00	5.80	4.90	5.50	197.57	245.08	144.00	144.17	29.45	1.02	1.62	28.27
3/20/2014 10:43	127.11	21.93	69.99	6.00	5.80	4.90	5.50	197.89	245.06	143.75	144.13	29.44	1.37	1.77	28.67
3/20/2014 10:44	127.11	21.90	70.40	6.00	5.80	4.90	5.50	197.89	245.00	143.75	144.02	29.51	1.60	1.56	28.28
3/20/2014 10:45	127.11	21.70	70.63	6.00	5.80	4.90	5.50	197.63	244.71	143.75	144.03	29.59	1.56	1.53	31.46
3/20/2014 10:46	127.11	21.68	70.80	6.00	5.80	4.90	5.50	196.82	243.83	143.75	144.07	29.71	1.53	2.10	30.40
3/20/2014 10:47	127.12	21.63	70.69	6.00	5.80	4.90	5.50	197.15	244.15	143.72	144.13	29.69	1.42	1.83	30.09
3/20/2014 10:48	127.11	21.68	70.30	6.00	5.80	4.90	5.50	198.35	244.93	143.72	144.32	29.63	1.18	1.91	29.59
3/20/2014 10:49	127.10	21.85	70.12	6.00	5.80	4.90	5.50	197.61	244.24	143.71	144.23	29.70	1.33	2.03	30.89
3/20/2014 10:50	127.10	21.82	70.18	6.00	5.80	4.90	5.50	196.88	243.67	143.68	143.96	29.79	1.41	1.72	31.02
3/20/2014 10:51															
Average	127.09	21.78	70.26	6.00	5.80	4.90	5.50	198.34	245.46	143.57	143.82	29.63	1.27	0.42	27.91

Time	CORRECTED REACTOR FEED MBPD	LIQUID TO GAS RATIO G/MSCF	REGEN COKE BURNING RATE MPPH	Unit 30 Scrubber spay nozzle Pressure psig	Unit 30 Scrubber 02 spay nozzle Pressure psig	Unit 30 Scrubber 03 spay nozzle Pressure psig	Unit 30 Scrubber 04 spay nozzle Pressure psig	OXYGEN & BLOWER FEED CORR. MSCF	THROAT VELOCITY feet/min	FLUE GAS STK TMP deg F	FLUE GAS SCRUBBER STK TMP deg F	Dry Flue Gas Rate MMOL/H	SCRUBBER STACK O2 %	SCRUBBER STACK SO2 ppm	SCRUBBER SELECTED NOX ppm
	25F3012A	*30C3532L*	*25CokeBN*	30SCRspray01psig.or	30SCRspray02psig.or	30SCRspray03psig.or	30SCRspray04psig.or	25Airtot	25C3147V	30TI6008	30TI1807	25F3147D	30AI6014	30AI6013	30AI6012
3/20/2014 9:31	127.07	21.81	70.16	6.00	5.80	4.90	5.50	198.89	246.16	143.14	143.49	*29.50*	*1.01*	*0.20*	27.71
3/20/2014 9:32	127.07	21.79	70.15	6.00	5.80	4.90	5.50	199.05	246.24	143.10	143.49	29.52	1.05	0.20	27.79
3/20/2014 9:33	127.07	21.78	70.32	6.00	5.80	4.90	5.50	199.00	246.20	143.12	143.51	29.55	1.04	0.20	27.20
3/20/2014 9:34	127.08	21.76	70.58	6.00	5.80	4.90	5.50	198.91	246.08	143.18	143.54	29.64	1.12	0.20	28.83
3/20/2014 9:35	127.08	21.79	70.80	6.00	5.80	4.90	5.50	199.13	246.25	143.19	143.62	29.67	1.12	0.20	28.66
3/20/2014 9:36	127.08	21.88	70.89	6.00	5.80	4.90	5.50	198.89	246.57	143.21	143.62	29.60	1.11	0.20	28.13
3/20/2014 9:37	127.08	21.90	70.83	6.00	5.80	4.90	5.50	198.82	246.19	143.22	143.64	29.53	0.98	0.20	27.85
3/20/2014 9:38	127.07	21.94	70.62	6.00	5.80	4.90	5.50	199.15	246.67	143.24	143.61	29.53	1.07	0.20	27.52
3/20/2014 9:39	127.07	21.90	70.56	6.00	5.80	4.90	5.50	199.95	247.18	143.20	143.51	29.57	1.21	0.20	28.71
3/20/2014 9:40	127.07	21.78	70.82	6.00	5.80	4.90	5.50	200.88	248.73	143.07	143.45	29.70	1.36	0.21	27.68
3/20/2014 9:41	127.08	21.74	70.92	6.00	5.80	4.90	5.50	200.00	248.28	142.98	143.18	29.76	1.47	0.21	27.78
3/20/2014 9:42	127.08	21.64	71.06	6.00	5.80	*4.90*	5.50	199.44	246.68	142.71	142.84	29.89	1.87	0.21	28.27
3/20/2014 9:43	127.08	21.63	71.24	6.00	5.80	4.90	5.50	198.87	245.82	142.81	142.90	29.93	1.64	0.20	29.07
3/20/2014 9:44	127.08	21.62	71.15	6.00	5.80	4.90	5.50	199.31	246.00	143.12	143.12	29.85	1.22	0.21	28.84
3/20/2014 9:45	127.08	21.64	70.75	6.00	5.80	4.90	5.50	199.44	246.54	143.11	143.33	29.81	1.05	0.21	27.57
3/20/2014 9:46	127.08	21.68	70.23	6.00	5.80	4.90	5.50	199.15	246.21	143.10	143.34	29.73	1.20	0.21	29.44
3/20/2014 9:47	127.07	21.71	69.94	6.00	5.80	4.90	5.50	198.61	245.68	143.14	143.37	29.63	1.21	0.21	29.12
3/20/2014 9:48	127.07	21.80	69.89	6.00	5.80	4.90	5.50	199.75	247.37	143.26	143.39	29.57	1.28	0.21	28.16
3/20/2014 9:49	127.08	21.80	69.94	6.00	5.80	4.90	5.50	199.71	247.17	143.25	143.47	29.57	1.40	0.20	27.86
3/20/2014 9:50	127.08	21.80	69.97	6.00	5.80	4.90	5.50	199.46	246.50	143.21	143.47	29.59	1.46	0.20	27.25
3/20/2014 9:51	127.07	21.78	70.10	6.00	5.80	4.90	5.50	199.05	246.39	143.20	143.49	29.68	1.52	0.20	28.58
3/20/2014 9:52	127.07	21.70	70.21	6.00	5.80	4.90	5.50	199.16	245.92	143.16	143.50	29.71	1.52	0.20	28.15
3/20/2014 9:53	127.08	21.73	70.16	6.00	5.80	4.90	5.50	199.03	245.71	143.19	143.53	29.69	1.38	0.20	27.14
3/20/2014 9:54	127.08	21.80	69.92	6.00	5.80	4.90	5.50	199.21	*246.77*	*143.28*	*143.55*	*29.62*	1.40	0.20	28.03
3/20/2014 9:55	127.07	21.78	69.68	6.00	5.80	4.90	5.50	199.61	247.40	143.24	143.62	29.60	1.22	0.20	28.08
3/20/2014 9:56	127.08	21.71	69.66	6.00	5.80	4.90	5.50	198.91	245.98	143.13	143.58	29.62	1.38	0.20	27.99
3/20/2014 9:57	127.08	21.71	69.79	6.00	5.80	4.90	5.50	198.29	245.83	143.13	143.47	29.69	1.33	0.20	26.96
3/20/2014 9:58	127.08	21.69	69.95	6.00	5.80	4.90	5.50	198.33	245.38	143.15	143.43	29.70	1.36	0.20	26.05
3/20/2014 9:59	127.09	21.71	70.06	6.00	5.80	4.90	5.50	198.36	245.08	143.24	143.30	29.71	1.39	0.20	26.39
3/20/2014 10:00	127.09	21.79	69.98	6.00	5.80	4.90	5.50	198.03	244.43	143.50	143.31	29.67	1.44	0.20	27.75
3/20/2014 10:01	127.09	21.79	69.94	6.00	5.80	4.90	5.50	197.86	245.18	143.55	143.43	29.66	1.32	0.20	28.27
3/20/2014 10:02	127.09	21.79	69.88	6.00	5.80	4.90	5.50	198.39	245.19	143.71	143.65	29.66	1.21	0.20	26.98
3/20/2014 10:03	127.08	21.82	69.99	6.00	5.80	4.90	5.50	197.87	244.62	143.67	143.70	29.73	1.33	0.20	26.98
3/20/2014 10:04	127.08	21.91	69.95	6.00	5.80	4.90	5.50	196.67	242.76	143.64	143.85	29.60	1.25	0.20	26.68
3/20/2014 10:05	127.09	21.90	69.82	*6.00*	*5.80*	*4.90*	5.50	196.88	242.97	143.85	143.90	29.51	1.02	0.20	26.55
3/20/2014 10:06	127.09	21.85	69.75	6.00	5.80	4.90	5.50	197.22	243.98	143.88	144.11	29.48	1.22	0.21	28.75
3/20/2014 10:07	127.09	21.85	69.70	6.00	5.80	4.90	5.50	197.69	245.15	143.98	144.32	29.40	1.19	0.21	27.52
3/20/2014 10:08	127.09	21.87	69.76	6.00	5.80	4.90	5.50	197.57	245.27	143.97	144.32	29.48	1.34	0.21	27.80
3/20/2014 10:09	127.09	21.88	69.98	6.00	5.80	4.90	5.50	197.99	245.52	143.94	144.30	29.55	1.25	0.20	28.74
3/20/2014 10:10	127.09	21.94	70.10	6.00	5.80	4.90	5.50	197.63	245.04	143.92	144.28	29.46	1.30	0.20	28.40
3/20/2014 10:11	127.08	21.91	70.14	6.00	5.80	4.90	5.50	197.76	245.18	143.85	144.22	29.39	1.45	0.20	27.22
3/20/2014 10:12	127.08	21.81	70.02	6.00	5.80	4.90	5.50	198.33	245.36	143.85	144.21	29.57	1.37	0.20	26.69
3/20/2014 10:13	127.10	21.81	70.13	6.00	5.80	4.90	5.50	197.77	244.54	143.84	144.19	29.63	1.19	0.20	27.09
3/20/2014 10:14	127.10	21.80	70.26	6.00	5.80	4.90	5.50	197.80	244.60	143.85	144.19	29.67	1.28	0.20	28.29
3/20/2014 10:15	127.10	21.82	70.28	6.00	5.80	4.90	5.50	197.98	244.93	143.89	144.20	29.70	1.13	0.20	27.95
3/20/2014 10:16	127.10	21.87	70.19	6.00	5.80	4.90	5.50	198.22	245.17	143.93	144.16	29.70	1.06	0.20	26.65
3/20/2014 10:17	127.10	21.89	70.20	6.00	5.80	4.90	5.50	*198.14*	*244.76*	*144.07*	*144.02*	29.67	0.99	0.20	25.96
3/20/2014 10:18	127.10	21.95	70.22	6.00	5.80	4.90	5.50	198.82	245.46	144.05	144.00	29.57	0.93	0.20	26.03
3/20/2014 10:19	127.10	21.90	70.22	6.00	5.80	4.90	5.50	198.54	245.43	144.01	143.92	29.62	0.98	0.20	25.17
3/20/2014 10:20	127.10	21.76	70.43	6.00	5.80	4.90	5.50	198.10	245.35	143.96	143.92	29.67	1.47	0.20	27.11
3/20/2014 10:21	127.10	21.76	70.67	6.00	5.80	4.90	5.50	198.04	245.20	143.83	143.91	29.66	1.35	0.20	29.06
3/20/2014 10:22	127.10	21.76	70.87	6.00	5.80	4.90	5.50	197.76	244.73	143.85	144.00	29.70	1.18	0.20	28.63
3/20/2014 10:23	127.10	21.74	70.89	6.00	5.80	4.90	5.50	197.69	244.93	143.94	144.26	29.64	1.23	0.20	27.33
3/20/2014 10:24	127.10	21.70	70.52	6.00	5.80	4.90	5.50	198.35	245.80	143.93	144.28	29.53	1.03	0.20	26.79
3/20/2014 10:25	127.11	21.70	70.16	6.00	5.80	4.90	5.50	198.54	246.42	143.93	144.33	29.51	1.06	0.20	25.87
3/20/2014 10:26	127.11	21.72	70.17	6.00	5.80	4.90	5.50	198.28	245.99	143.88	144.29	29.57	1.43	0.20	27.56
3/20/2014 10:27	127.09	21.73	70.37	6.00	5.80	4.90	5.50	198.40	246.00	143.73	144.14	29.63	1.55	0.20	26.77
3/20/2014 10:28	*127.09*	*21.76*	*70.45*	6.00	5.80	4.90	5.50	199.03	246.33	143.70	144.11	29.63	1.47	0.20	27.78
3/20/2014 10:29	127.10	21.74	70.47	6.00	5.80	4.90	5.50	199.51	246.89	143.60	*144.03*	*29.66*	*1.40*	*0.20*	*27.75*
3/20/2014 10:30	127.10	21.69	70.51	6.00	5.80	4.90	5.50	198.44	245.53	143.61	144.06	29.74	1.49	0.20	27.68
3/20/2014 10:31	127.10	21.71	70.45	6.00	5.80	4.90	5.50	197.67	244.88	143.65	144.16	29.75	1.57	0.20	27.42
3/20/2014 10:32	127.10	21.78	70.22	6.00	5.80	4.90	5.50	197.88	244.88	143.71	144.18	29.65	1.33	0.20	26.62
3/20/2014 10:33	127.11	21.79	70.03	6.00	5.80	4.90	5.50	198.24	245.06	143.92	144.26	29.60	1.13	0.21	26.60
3/20/2014 10:34	127.11	21.85	69.80	6.00	5.80	4.90	5.50	198.35	245.38	143.87	144.16	29.56	1.19	0.21	26.74
3/20/2014 10:35	127.10	21.82	69.62	6.00	5.80	4.90	5.50	197.95	245.07	143.74	143.87	29.55	1.37	0.20	27.46
3/20/2014 10:36	127.10	21.75	69.82	6.00	5.80	4.90	5.50	198.08	245.28	143.72	143.77	29.70	1.36	0.20	27.92
3/20/2014 10:37	127.11	21.73	70.26	6.00	5.80	4.90	5.50	197.58	243.66	143.67	143.46	29.77	1.36	0.20	29.44

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/20/2014 10:38	127.11	21.66	70.55	6.00	5.80	4.90	5.50	196.98	243.58	143.71	143.54	29.76	1.21	0.40	29.49
3/20/2014 10:39	127.10	21.70	70.53	6.00	5.80	4.90	5.50	196.64	243.64	143.84	143.86	29.74	1.10	1.04	29.40
3/20/2014 10:40	127.10	21.83	70.37	6.00	5.80	4.90	5.50	197.20	244.49	143.90	144.13	29.69	0.86	1.21	27.91
3/20/2014 10:41	127.11	21.85	70.07	6.00	5.80	4.90	5.50	197.46	244.64	144.08	144.14	29.52	0.79	1.43	26.19
3/20/2014 10:42	127.11	21.92	69.91	6.00	5.80	4.90	5.50	197.57	245.08	144.00	144.17	29.45	1.02	1.62	28.27
3/20/2014 10:43	127.11	21.93	69.99	6.00	5.80	4.90	5.50	197.89	245.06	143.75	144.13	29.44	1.37	1.77	28.67
3/20/2014 10:44	127.11	21.90	70.40	6.00	5.80	4.90	5.50	197.89	245.00	143.75	144.02	29.51	1.60	1.56	28.28
3/20/2014 10:45	127.11	21.70	70.63	6.00	5.80	4.90	5.50	197.63	244.71	143.75	144.03	29.59	1.56	1.53	31.46
3/20/2014 10:46	127.11	21.68	70.80	6.00	5.80	4.90	5.50	196.82	243.83	143.75	144.07	29.71	1.53	2.10	30.40
3/20/2014 10:47	127.12	21.63	70.69	6.00	5.80	4.90	5.50	197.15	244.15	143.72	144.13	29.69	1.42	1.83	30.09
3/20/2014 10:48	127.11	21.68	70.30	6.00	5.80	4.90	5.50	198.35	244.93	143.72	144.32	29.63	1.18	1.91	29.59
3/20/2014 10:49	127.10	21.85	70.12	6.00	5.80	4.90	5.50	197.61	244.24	143.71	144.23	29.70	1.33	2.03	30.89
3/20/2014 10:50	127.10	21.82	70.18	6.00	5.80	4.90	5.50	196.88	243.67	143.68	143.96	29.79	1.41	1.72	31.02
3/20/2014 10:51	127.11	21.76	70.42	6.00	5.80	4.90	5.50	196.51	243.78	143.59	143.95	29.81	1.36	1.87	31.73
3/20/2014 10:52	127.11	21.76	70.57	6.00	5.80	4.90	5.50	196.69	243.87	143.67	143.91	29.73	1.17	1.78	31.81
3/20/2014 10:53	127.11	21.74	70.40	6.00	5.80	4.90	5.50	197.28	243.38	143.94	143.88	29.64	0.89	2.19	29.38
3/20/2014 10:54	127.11	21.79	70.05	6.00	5.80	4.90	5.50	197.54	244.37	143.86	143.79	29.50	0.90	2.33	29.59
3/20/2014 10:55	127.10	21.94	69.96	6.00	5.80	4.90	5.50	197.86	244.96	143.60	143.72	29.50	1.15	1.79	30.44
3/20/2014 10:56	127.10	21.94	70.16	6.00	5.80	4.90	5.50	198.09	244.71	143.54	143.50	29.52	1.47	1.32	30.72
3/20/2014 10:57	127.10	21.91	70.37	6.00	5.80	4.90	5.50	197.67	243.95	143.37	143.54	29.51	1.42	1.12	29.63
3/20/2014 10:58	127.10	21.89	70.63	6.00	5.80	4.90	5.50	197.13	243.83	143.39	143.66	29.66	1.47	1.23	30.24
3/20/2014 10:59	127.11	21.80	70.72	6.00	5.80	4.90	5.50	196.46	243.44	143.45	143.71	29.69	1.58	0.74	30.36
3/20/2014 11:00	127.11	21.77	70.59	6.00	5.80	4.90	5.50	196.17	243.30	143.47	143.85	29.70	1.36	0.50	30.36
3/20/2014 11:01	127.11	21.68	70.53	6.00	5.80	4.90	5.50	196.66	243.34	143.54	143.88	29.72	1.29	0.56	29.16
3/20/2014 11:02	127.11	21.68	70.31	6.00	5.80	4.90	5.50	197.36	244.45	143.54	143.98	29.72	1.09	0.52	28.98
3/20/2014 11:03	127.11	21.69	70.07	6.00	5.80	4.90	5.50	196.68	243.83	143.57	144.00	29.66	1.03	0.58	28.45
3/20/2014 11:04	127.11	21.72	69.98	6.00	5.80	4.90	5.50	197.22	244.42	143.58	144.06	29.71	1.03	0.54	28.44
3/20/2014 11:05	127.10	21.82	70.12	6.00	5.80	4.90	5.50	196.94	242.95	143.61	144.04	29.59	1.06	0.44	28.06
3/20/2014 11:06	127.11	21.83	70.11	6.00	5.80	4.90	5.50	197.55	243.91	143.63	143.98	29.55	0.96	0.42	27.18
3/20/2014 11:07	127.12	21.85	70.05	6.00	5.80	4.90	5.50	197.82	244.70	143.68	143.92	29.48	1.06	0.40	28.00
3/20/2014 11:08	127.12	21.86	70.00	6.00	5.80	4.90	5.50	197.98	244.77	143.63	143.71	29.44	1.26	0.44	28.86
3/20/2014 11:09	127.11	21.84	70.12	6.00	5.80	4.90	5.50	197.77	244.79	143.50	143.64	29.50	1.23	0.39	29.39
3/20/2014 11:10	127.11	21.83	70.16	6.00	5.80	4.90	5.50	197.27	244.39	143.50	143.41	29.49	1.20	0.48	28.83
3/20/2014 11:11	127.12	21.79	70.30	6.00	5.80	4.90	5.50	197.85	245.00	143.49	143.48	29.57	1.07	0.50	28.93
3/20/2014 11:12															
Average	127.09	21.79	70.26	6.00	5.80	4.90	5.50	198.12	245.18	143.57	143.81	29.63	1.26	0.53	28.23

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI5008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147O	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/20/2014 11:55	127.12	21.90	70.35	6.00	5.80	4.90	5.50	197.33	243.38	143.28	143.40	29.54	1.32	0.20	27.75
3/20/2014 11:56	127.12	21.87	70.37	6.00	5.80	4.90	5.50	197.08	244.13	143.29	143.29	29.56	1.31	0.20	27.15
3/20/2014 11:57	127.12	21.79	70.29	6.00	5.80	4.90	5.50	197.46	244.86	143.32	143.26	29.61	1.39	0.20	25.10
3/20/2014 11:58	127.12	21.82	70.25	6.00	5.80	4.90	5.50	197.08	243.91	143.28	143.15	29.60	1.47	0.20	27.90
3/20/2014 11:59	127.11	21.93	70.14	6.00	5.80	4.90	5.50	197.26	243.97	143.16	143.21	29.58	1.28	0.20	26.62
3/20/2014 12:00	127.11	21.87	70.13	6.00	5.80	4.90	5.50	197.03	243.91	143.14	143.39	29.62	1.35	0.20	26.38
3/20/2014 12:01	127.11	21.71	70.11	6.00	5.80	4.90	5.50	196.07	243.16	143.10	143.42	29.70	1.40	0.20	26.22
3/20/2014 12:02	127.11	21.72	70.13	6.00	5.80	4.90	5.50	196.50	243.21	143.14	143.51	29.66	1.32	0.20	27.35
3/20/2014 12:03	127.11	21.75	70.01	6.00	5.80	4.90	5.50	196.70	243.40	143.29	143.57	29.66	1.17	0.20	25.31
3/20/2014 12:04	127.11	21.79	69.93	6.00	5.80	4.90	5.50	196.46	243.20	143.31	143.74	29.63	1.19	0.20	25.44
3/20/2014 12:05	127.10	21.91	69.82	6.00	5.80	4.90	5.50	196.38	242.52	143.37	143.73	29.59	1.21	0.20	26.16
3/20/2014 12:06	127.11	21.87	69.77	6.00	5.80	4.90	5.50	196.79	242.93	143.35	143.71	29.49	1.18	0.20	26.36
3/20/2014 12:07	127.12	21.75	69.77	6.00	5.80	4.90	5.50	196.92	244.17	143.30	143.64	29.49	1.01	0.20	24.89
3/20/2014 12:08	127.12	21.77	69.81	6.00	5.80	4.90	5.50	197.08	243.92	143.25	143.36	29.48	1.24	0.20	25.87
3/20/2014 12:09	127.12	21.81	70.03	6.00	5.80	4.90	5.50	196.27	242.84	143.09	143.16	29.55	1.36	0.20	25.34
3/20/2014 12:10	127.12	21.82	70.39	6.00	5.80	4.90	5.50	195.92	241.96	143.17	143.24	29.62	1.38	0.20	25.45
3/20/2014 12:11	127.12	21.85	70.59	6.00	5.80	4.90	5.50	196.01	242.55	143.53	143.56	29.66	1.14	0.20	25.18
3/20/2014 12:12	127.12	21.85	70.55	6.00	5.80	4.90	5.50	196.23	242.58	143.77	143.76	29.65	0.96	0.20	23.94
3/20/2014 12:13	127.13	21.87	70.39	6.00	5.80	4.90	5.50	196.34	242.67	143.76	143.80	29.58	1.05	0.20	25.41
3/20/2014 12:14	127.13	21.87	70.18	6.00	5.80	4.90	5.50	197.10	243.05	143.75	143.91	29.50	1.13	0.20	25.39
3/20/2014 12:15	127.14	21.88	70.14	6.00	5.80	4.90	5.50	196.92	244.32	143.74	143.94	29.50	1.22	0.20	24.83
3/20/2014 12:16	127.13	21.84	70.31	6.00	5.80	4.90	5.50	197.03	244.46	143.69	144.04	29.55	1.27	0.20	23.78
3/20/2014 12:17	127.12	21.71	70.60	6.00	5.80	4.90	5.50	196.81	243.53	143.67	144.02	29.69	1.41	0.20	26.02
3/20/2014 12:18	127.12	21.73	70.92	6.00	5.80	4.90	5.50	196.36	243.55	143.59	143.97	29.73	1.33	0.20	26.14
3/20/2014 12:19	127.10	21.80	70.84	6.00	5.80	4.90	5.50	197.05	243.59	143.63	144.05	29.65	0.94	0.21	23.27
3/20/2014 12:20	127.11	21.80	70.54	6.00	5.80	4.90	5.50	197.33	243.57	143.75	144.28	29.61	0.91	0.21	24.79
3/20/2014 12:21	127.12	21.80	70.39	6.00	5.80	4.90	5.50	197.44	243.36	143.72	144.19	29.66	1.07	0.20	26.13
3/20/2014 12:22	127.12	21.81	70.49	6.00	5.80	4.90	5.50	197.35	242.94	143.63	143.90	29.63	1.04	0.20	24.77
3/20/2014 12:23	127.13	21.84	70.54	6.00	5.80	4.90	5.50	196.83	242.96	143.61	143.82	29.58	1.10	0.20	24.88
3/20/2014 12:24	127.13	21.81	70.67	6.00	5.80	4.90	5.50	196.06	242.85	143.54	143.57	29.61	0.98	0.20	24.77
3/20/2014 12:25	127.14	21.72	70.64	6.00	5.80	4.90	5.50	196.12	242.76	143.53	143.55	29.54	0.98	0.20	24.18
3/20/2014 12:26	127.13	21.73	70.57	6.00	5.80	4.90	5.50	197.25	244.33	143.49	143.48	29.59	1.18	0.20	26.59
3/20/2014 12:27	127.12	21.77	70.71	6.00	5.80	4.90	5.50	197.97	245.08	143.45	143.50	29.58	1.30	0.20	26.44
3/20/2014 12:28	127.12	21.79	70.81	6.00	5.80	4.90	5.50	197.48	244.58	143.34	143.56	29.62	1.44	0.20	26.17
3/20/2014 12:29	127.11	21.86	70.78	6.00	5.80	4.90	5.50	196.62	243.19	143.35	143.61	29.61	1.44	0.20	26.38
3/20/2014 12:30	127.12	21.87	70.65	6.00	5.80	4.90	5.50	196.21	243.39	143.39	143.77	29.56	1.28	0.20	25.05
3/20/2014 12:31	127.13	21.89	70.41	6.00	5.80	4.90	5.50	196.14	242.82	143.41	143.80	29.54	1.13	0.20	25.19
3/20/2014 12:32	127.13	21.89	70.11	6.00	5.80	4.90	5.50	196.82	243.25	143.48	143.90	29.53	1.15	0.20	25.60
3/20/2014 12:33	127.13	21.91	69.84	6.00	5.80	4.90	5.50	197.92	244.53	143.45	143.86	29.49	1.16	0.20	25.60
3/20/2014 12:34	127.13	21.84	70.09	6.00	5.80	4.90	5.50	198.28	244.81	143.34	143.74	29.59	1.24	0.20	26.17
3/20/2014 12:35	127.12	21.65	70.35	6.00	5.80	4.90	5.50	198.02	245.19	143.35	143.70	29.65	1.42	0.20	27.87
3/20/2014 12:36	127.12	21.68	70.53	6.00	5.80	4.90	5.50	196.90	243.85	143.37	143.50	29.72	1.29	0.25	28.19
3/20/2014 12:37	127.12	21.76	70.94	6.00	5.80	4.90	5.50	197.28	243.68	143.32	143.22	29.83	1.45	0.48	29.59
3/20/2014 12:38	127.12	21.75	70.83	6.00	5.80	4.90	5.50	197.02	243.55	143.16	143.27	29.76	1.60	0.82	30.79
3/20/2014 12:39	127.12	21.71	70.49	6.00	5.80	4.90	5.50	197.36	244.46	143.21	143.45	29.66	1.13	1.10	30.67
3/20/2014 12:40	127.12	21.73	70.36	6.00	5.80	4.90	5.50	196.77	243.06	143.37	143.43	29.68	1.20	1.18	30.15
3/20/2014 12:41	127.12	21.77	70.21	6.00	5.80	4.90	5.50	196.12	242.48	143.33	143.38	29.69	1.49	1.27	29.94
3/20/2014 12:42	127.12	21.76	70.18	6.00	5.80	4.90	5.50	196.56	243.02	143.23	143.46	29.64	1.44	1.43	30.76
3/20/2014 12:43	127.13	21.70	70.22	6.00	5.80	4.90	5.50	197.23	244.33	143.27	143.68	29.69	1.25	1.40	30.50
3/20/2014 12:44	127.13	21.72	70.05	6.00	5.80	4.90	5.50	196.93	243.40	143.39	143.68	29.56	1.19	1.10	30.05
3/20/2014 12:45	127.12	21.78	69.75	6.00	5.80	4.90	5.50	197.50	243.62	143.37	143.68	29.48	1.30	1.63	31.01
3/20/2014 12:46	127.12	21.76	69.64	6.00	5.80	4.90	5.50	196.75	243.80	143.31	143.70	29.57	1.35	1.57	30.89
3/20/2014 12:47	127.12	21.78	69.84	6.00	5.80	4.90	5.50	196.44	242.38	143.35	143.76	29.63	1.44	1.45	30.53
3/20/2014 12:48	127.12	22.00	70.00	6.00	5.80	4.90	5.50	196.47	242.35	143.46	143.76	29.58	1.18	1.76	30.57
3/20/2014 12:49	127.12	21.98	70.02	6.00	5.80	4.90	5.50	195.94	242.41	143.45	143.76	29.59	1.04	2.10	30.97
3/20/2014 12:50	127.12	21.94	70.03	6.00	5.80	4.90	5.50	196.36	243.32	143.41	143.73	29.60	1.21	2.08	31.01
3/20/2014 12:51	127.13	21.92	69.88	6.00	5.80	4.90	5.50	197.85	244.94	143.47	143.66	29.55	0.96	1.96	28.45
3/20/2014 12:52	127.13	21.89	69.95	6.00	5.80	4.90	5.50	198.15	245.78	143.59	143.59	29.53	1.23	1.75	28.95
3/20/2014 12:53	127.13	21.90	69.92	6.00	5.80	4.90	5.50	197.96	245.38	143.38	143.34	29.47	1.37	1.24	29.84
3/20/2014 12:54	127.13	21.87	69.89	6.00	5.80	4.90	5.50	197.46	244.19	143.37	143.39	29.47	1.51	0.83	28.22
3/20/2014 12:55	127.12	21.68	70.17	6.00	5.80	4.90	5.50	196.72	244.01	143.32	143.53	29.61	1.50	0.71	29.20
3/20/2014 12:56	127.12	21.71	70.29	6.00	5.80	4.90	5.50	196.74	243.33	143.36	143.59	29.65	1.26	0.51	29.70
3/20/2014 12:57	127.11	21.80	70.17	6.00	5.80	4.90	5.50	196.56	242.84	143.50	143.78	29.66	1.13	0.48	29.03
3/20/2014 12:58	127.12	21.80	70.01	6.00	5.80	4.90	5.50	196.65	242.96	143.52	143.82	29.67	1.18	0.36	26.85
3/20/2014 12:59	127.14	21.80	69.83	6.00	5.80	4.90	5.50	196.63	243.31	143.59	143.93	29.59	1.23	0.45	27.34
3/20/2014 13:00	127.14	21.85	69.74	6.00	5.80	4.90	5.50	196.57	243.18	143.58	143.96	29.48	1.21	0.59	28.96
3/20/2014 13:01	127.13	22.00	69.75	6.00	5.80	4.90	5.50	195.67	242.77	143.56	144.05	29.45	1.24	0.35	28.92

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3S32L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI2807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/20/2014 13:02	127.13	21.95	69.82	6.00	5.80	4.90	5.50	196.06	242.83	143.56	143.98	29.50	1.19	0.53	28.80
3/20/2014 13:03															
Average	127.12	21.82	70.23	6.00	5.80	4.90	5.50	196.86	243.54	143.42	143.65	29.60	1.24	0.55	27.26

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT *VELOCITY* feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 *ppm* 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/20/2014 13:07	127.15	21.77	70.02	6.00	5.80	4.90	5.50	197.35	244.26	143.50	143.31	29.50	1.49	0.29	28.27
3/20/2014 13:08	127.14	21.75	70.23	6.00	5.80	4.90	5.50	196.04	243.34	143.50	143.41	29.54	1.29	0.20	27.59
3/20/2014 13:09	127.12	21.69	70.43	6.00	5.80	4.90	5.50	195.62	242.62	143.52	143.71	29.64	1.35	0.21	28.47
3/20/2014 13:10	127.12	21.72	70.62	6.00	5.80	4.90	5.50	194.51	241.61	143.59	143.81	29.72	1.41	0.23	28.58
3/20/2014 13:11	127.13	21.82	70.59	6.00	5.80	4.90	5.50	194.00	240.93	143.79	144.10	29.63	0.91	0.22	25.84
3/20/2014 13:12	127.13	21.86	70.24	6.00	5.80	4.90	5.50	194.83	241.28	143.80	144.13	29.47	0.90	0.20	26.26
3/20/2014 13:13	127.14	21.96	69.92	6.00	5.80	4.90	5.50	196.05	242.64	143.82	144.25	29.43	0.92	0.20	25.77
3/20/2014 13:14	127.13	21.95	69.89	6.00	5.80	4.90	5.50	196.24	243.38	143.77	144.20	29.44	1.13	0.20	27.66
3/20/2014 13:15	127.13	21.93	70.01	6.00	5.80	4.90	5.50	196.83	242.93	143.63	144.06	29.41	1.34	0.28	28.90
3/20/2014 13:16	127.12	21.90	70.21	6.00	5.80	4.90	5.50	196.66	243.02	143.60	143.95	29.48	1.30	0.46	27.82
3/20/2014 13:17	127.12	21.79	70.57	6.00	5.80	4.90	5.50	195.96	241.80	143.51	143.63	29.56	1.28	0.26	29.44
3/20/2014 13:18	127.12	21.81	70.60	6.00	5.80	4.90	5.50	195.78	242.80	143.58	143.66	29.54	1.11	0.29	27.25
3/20/2014 13:19	127.12	21.87	70.34	6.00	5.80	4.90	5.50	196.87	243.53	143.80	143.75	29.53	1.03	0.39	28.26
3/20/2014 13:20	127.13	21.85	70.22	6.00	5.80	4.90	5.50	196.74	242.90	143.72	143.67	29.60	1.36	0.44	28.59
3/20/2014 13:21	127.15	21.79	70.37	6.00	5.80	4.90	5.50	195.87	242.84	143.47	143.50	29.57	1.61	0.25	29.36
3/20/2014 13:22	127.14	21.77	70.38	6.00	5.80	4.90	5.50	196.14	242.69	143.54	143.81	29.60	1.33	0.20	28.79
3/20/2014 13:23	127.14	21.70	70.38	6.00	5.80	4.90	5.50	196.24	242.82	143.76	143.85	29.56	1.32	0.23	29.22
3/20/2014 13:24	127.14	21.75	70.20	6.00	5.80	4.90	5.50	196.43	243.06	143.79	143.98	29.54	1.19	0.27	28.77
3/20/2014 13:25	127.13	21.92	70.07	6.00	5.80	4.90	5.50	196.09	242.91	143.90	144.05	29.53	1.13	0.20	27.90
3/20/2014 13:26	127.13	21.92	69.96	6.00	5.80	4.90	5.50	196.27	243.72	143.92	144.27	29.50	1.27	0.20	29.06
3/20/2014 13:27	127.13	21.90	69.90	6.00	5.80	4.90	5.50	196.50	243.01	144.01	144.31	29.46	1.24	0.20	28.19
3/20/2014 13:28	127.13	21.88	69.88	6.00	5.80	4.90	5.50	196.74	243.00	144.01	144.44	29.50	1.17	0.20	29.32
3/20/2014 13:29	127.12	21.83	69.95	6.00	5.80	4.90	5.50	196.35	242.99	144.00	144.37	29.58	1.43	0.21	29.70
3/20/2014 13:30	127.12	21.81	70.12	6.00	5.80	4.90	5.50	196.25	243.16	144.02	144.16	29.66	1.32	0.21	28.02
3/20/2014 13:31	127.12	21.77	70.39	6.00	5.80	4.90	5.50	196.73	243.36	144.08	144.11	29.63	1.15	0.20	26.81
3/20/2014 13:32	127.12	21.74	70.42	6.00	5.80	4.90	5.50	195.64	242.40	144.05	143.98	29.66	1.23	0.20	26.80
3/20/2014 13:33	127.12	21.66	70.49	6.00	5.80	4.90	5.50	195.49	242.30	143.94	143.98	29.76	1.26	0.20	29.09
3/20/2014 13:34	127.12	21.71	70.45	6.00	5.80	4.90	5.50	195.27	241.97	143.96	143.98	29.64	1.02	0.20	27.09
3/20/2014 13:35	127.13	21.87	70.31	6.00	5.80	4.90	5.50	195.45	242.18	144.04	144.02	29.57	1.03	0.20	25.98
3/20/2014 13:36	127.13	21.86	70.21	6.00	5.80	4.90	5.50	196.18	242.83	144.01	144.14	29.53	1.12	0.20	26.71
3/20/2014 13:37	127.13	21.86	70.10	6.00	5.80	4.90	5.50	196.05	242.84	143.91	144.16	29.47	1.17	0.20	28.32
3/20/2014 13:38	127.13	21.91	70.03	6.00	5.80	4.90	5.50	195.97	242.86	143.92	144.22	29.40	1.40	0.20	25.88
3/20/2014 13:39	127.14	22.04	70.16	6.00	5.80	4.90	5.50	195.70	242.58	143.93	144.25	29.42	1.45	0.20	25.79
3/20/2014 13:40	127.14	21.96	70.40	6.00	5.80	4.90	5.50	195.63	241.65	143.97	144.37	29.60	1.30	0.20	26.94
3/20/2014 13:41	127.13	21.67	70.55	6.00	5.80	4.90	5.50	195.22	241.36	144.09	144.39	29.70	1.26	0.20	26.78
3/20/2014 13:42	127.13	21.73	70.53	6.00	5.80	4.90	5.50	194.80	240.51	144.11	144.46	29.67	1.23	0.20	26.27
3/20/2014 13:43	127.12	21.89	70.40	6.00	5.80	4.90	5.50	195.52	240.95	144.17	144.43	29.58	1.07	0.20	26.22
3/20/2014 13:44	127.12	21.86	70.19	6.00	5.80	4.90	5.50	196.62	242.43	144.15	144.25	29.64	0.93	0.20	26.64
3/20/2014 13:45	127.13	21.75	70.35	6.00	5.80	4.90	5.50	196.33	242.85	144.09	143.97	29.68	1.27	0.20	28.66
3/20/2014 13:46	127.12	21.74	70.44	6.00	5.80	4.90	5.50	196.44	242.97	144.11	143.98	29.62	1.26	0.20	28.75
3/20/2014 13:47	127.12	21.78	70.40	6.00	5.80	4.90	5.50	197.10	244.61	144.16	144.03	29.55	1.32	0.20	27.05
3/20/2014 13:48	127.12	21.98	70.31	6.00	5.80	4.90	5.50	196.39	244.31	144.08	144.02	29.56	1.46	0.20	27.82
3/20/2014 13:49	127.12	21.91	70.44	6.00	5.80	4.90	5.50	196.14	243.27	143.82	144.06	29.64	1.61	0.20	28.42
3/20/2014 13:50	127.12	21.72	70.38	6.00	5.80	4.90	5.50	196.00	242.88	143.91	144.33	29.61	1.40	0.20	27.75
3/20/2014 13:51	127.14	21.74	70.11	6.00	5.80	4.90	5.50	196.67	242.91	144.18	144.52	29.49	0.98	0.20	25.41
3/20/2014 13:52	127.13	21.81	69.91	6.00	5.80	4.90	5.50	196.73	242.98	144.09	144.48	29.51	1.03	0.20	24.89
3/20/2014 13:53	127.13	21.81	69.94	6.00	5.80	4.90	5.50	196.63	242.85	143.83	144.33	29.63	1.28	0.20	26.98
3/20/2014 13:54	127.13	21.82	70.09	6.00	5.80	4.90	5.50	195.86	242.44	143.86	144.35	29.62	1.09	0.20	26.79
3/20/2014 13:55	127.12	21.85	70.20	6.00	5.80	4.90	5.50	196.06	242.63	143.99	144.40	29.58	1.16	0.20	25.78
3/20/2014 13:56	127.12	21.94	70.23	6.00	5.80	4.90	5.50	196.29	243.26	144.01	144.34	29.55	1.00	0.20	24.16
3/20/2014 13:57	127.12	21.93	70.13	6.00	5.80	4.90	5.50	196.13	243.03	144.07	144.12	29.54	0.97	0.20	24.46
3/20/2014 13:58	127.12	21.88	70.18	6.00	5.80	4.90	5.50	196.15	242.64	144.03	143.88	29.61	1.12	0.20	26.43
3/20/2014 13:59	127.13	21.87	70.35	6.00	5.80	4.90	5.50	196.14	243.37	143.92	143.87	29.57	1.26	0.20	25.68
3/20/2014 14:00	127.13	21.86	70.40	6.00	5.80	4.90	5.50	196.08	242.78	143.93	143.83	29.54	1.18	0.20	25.15
3/20/2014 14:01	127.14	21.84	70.37	6.00	5.80	4.90	5.50	196.57	242.78	143.97	143.89	29.47	1.20	0.20	25.51
3/20/2014 14:02	127.13	21.76	70.31	6.00	5.80	4.90	5.50	196.48	242.78	143.92	144.06	29.49	1.18	0.20	26.81
3/20/2014 14:03	127.12	21.78	70.32	6.00	5.80	4.90	5.50	196.17	242.67	143.75	144.12	29.51	1.32	0.20	27.46
3/20/2014 14:04	127.12	21.82	70.35	6.00	5.80	4.90	5.50	196.11	242.50	143.83	144.28	29.58	1.17	0.20	26.79
3/20/2014 14:05	127.12	21.82	70.34	6.00	5.80	4.90	5.50	196.39	243.24	144.07	144.31	29.53	1.17	0.20	24.80
3/20/2014 14:06	127.12	21.82	70.27	6.00	5.80	4.90	5.50	196.18	243.38	144.03	144.39	29.47	1.19	0.20	24.57
3/20/2014 14:07	127.11	21.88	70.06	6.00	5.80	4.90	5.50	195.19	242.12	143.90	144.37	29.38	1.11	0.20	24.03
3/20/2014 14:08	127.11	22.05	69.90	6.00	5.80	4.90	5.50	195.16	241.65	143.94	144.31	29.38	1.19	0.20	24.86
3/20/2014 14:09	127.11	22.00	69.93	6.00	5.80	4.90	5.50	195.48	241.96	144.05	144.22	29.42	1.04	0.20	26.01
3/20/2014 14:10															
Average	127.13	21.84	70.24	6.00	5.80	4.90	5.50	196.06	242.70	143.90	144.09	29.55	1.21	0.22	27.10

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/20/2014 13:26	127.13	21.92	69.96	6.00	5.80	4.90	5.50	196.27	243.72	143.92	144.27	29.50	1.27	0.20	29.06
3/20/2014 13:27	127.13	21.90	69.90	6.00	5.80	4.90	5.50	196.50	243.01	144.01	144.31	29.46	1.24	0.20	28.19
3/20/2014 13:28	127.13	21.88	69.88	6.00	5.80	4.90	5.50	196.74	243.00	144.01	144.44	29.50	1.17	0.20	29.32
3/20/2014 13:29	127.12	21.83	69.95	6.00	5.80	4.90	5.50	196.35	242.99	144.00	144.37	29.58	1.43	0.21	29.70
3/20/2014 13:30	127.12	21.81	70.12	6.00	5.80	4.90	5.50	196.25	243.16	144.02	144.16	29.66	1.32	0.21	28.02
3/20/2014 13:31	127.12	21.77	70.39	6.00	5.80	4.90	5.50	196.73	243.36	144.08	144.11	29.63	1.15	0.20	26.81
3/20/2014 13:32	127.12	21.74	70.42	6.00	5.80	4.90	5.50	195.64	242.40	144.05	143.98	29.66	1.23	0.20	26.80
3/20/2014 13:33	127.12	21.66	70.49	6.00	5.80	4.90	5.50	195.49	242.30	143.94	143.98	29.76	1.26	0.20	29.09
3/20/2014 13:34	127.12	21.71	70.45	6.00	5.80	4.90	5.50	195.27	241.97	143.96	143.98	29.64	1.02	0.20	27.09
3/20/2014 13:35	127.13	21.87	70.31	6.00	5.80	4.90	5.50	195.45	242.18	144.04	144.02	29.57	1.03	0.20	25.98
3/20/2014 13:36	127.13	21.86	70.21	6.00	5.80	4.90	5.50	196.18	242.83	144.01	144.14	29.53	1.12	0.20	26.71
3/20/2014 13:37	127.13	21.86	70.10	6.00	5.80	4.90	5.50	196.05	242.84	143.91	144.16	29.47	1.17	0.20	28.32
3/20/2014 13:38	127.13	21.91	70.03	6.00	5.80	4.90	5.50	195.97	242.85	143.92	144.22	29.40	1.40	0.20	25.88
3/20/2014 13:39	127.14	22.04	70.16	6.00	5.80	4.90	5.50	195.70	242.58	143.93	144.25	29.42	1.45	0.20	25.79
3/20/2014 13:40	127.14	21.96	70.40	6.00	5.80	4.90	5.50	195.63	241.65	143.97	144.37	29.60	1.30	0.20	26.94
3/20/2014 13:41	127.13	21.67	70.55	6.00	5.80	4.90	5.50	195.22	241.36	144.09	144.39	29.70	1.26	0.20	26.78
3/20/2014 13:42	127.13	21.73	70.53	6.00	5.80	4.90	5.50	194.80	240.51	144.11	144.46	29.67	1.23	0.20	26.27
3/20/2014 13:43	127.12	21.89	70.40	6.00	5.80	4.90	5.50	195.52	240.95	144.17	144.43	29.58	1.07	0.20	26.22
3/20/2014 13:44	127.12	21.86	70.19	6.00	5.80	4.90	5.50	196.62	242.43	144.15	144.25	29.64	0.93	0.20	26.64
3/20/2014 13:45	127.13	21.75	70.35	6.00	5.80	4.90	5.50	196.33	242.85	144.09	143.97	29.68	1.27	0.20	28.66
3/20/2014 13:46	127.12	21.74	70.44	6.00	5.80	4.90	5.50	196.44	242.97	144.11	143.98	29.62	1.26	0.20	28.75
3/20/2014 13:47	127.12	21.78	70.40	6.00	5.80	4.90	5.50	197.10	244.61	144.16	144.03	29.55	1.32	0.20	27.05
3/20/2014 13:48	127.12	21.98	70.31	6.00	5.80	4.90	5.50	196.39	244.31	144.08	144.02	29.56	1.46	0.20	27.82
3/20/2014 13:49	127.12	21.91	70.44	6.00	5.80	4.90	5.50	196.14	243.27	143.82	144.06	29.64	1.61	0.20	28.42
3/20/2014 13:50	127.12	21.72	70.38	6.00	5.80	4.90	5.50	196.00	242.88	143.91	144.33	29.61	1.40	0.20	27.75
3/20/2014 13:51	127.14	21.74	70.11	6.00	5.80	4.90	5.50	196.67	242.91	144.18	144.52	29.49	0.98	0.20	25.41
3/20/2014 13:52	127.13	21.81	69.91	6.00	5.80	4.90	5.50	196.73	242.98	144.09	144.48	29.51	1.03	0.20	24.89
3/20/2014 13:53	127.13	21.81	69.94	6.00	5.80	4.90	5.50	196.63	242.85	143.83	144.33	29.63	1.28	0.20	26.98
3/20/2014 13:54	127.13	21.82	70.09	6.00	5.80	4.90	5.50	195.86	242.44	143.86	144.35	29.62	1.09	0.20	26.79
3/20/2014 13:55	127.12	21.85	70.20	6.00	5.80	4.90	5.50	196.06	242.63	143.99	144.40	29.58	1.16	0.20	25.78
3/20/2014 13:56	127.12	21.94	70.23	6.00	5.80	4.90	5.50	196.29	243.26	144.01	144.34	29.55	1.00	0.20	24.16
3/20/2014 13:57	127.12	21.93	70.13	6.00	5.80	4.90	5.50	196.13	243.03	144.07	144.12	29.54	0.97	0.20	24.46
3/20/2014 13:58	127.12	21.88	70.18	6.00	5.80	4.90	5.50	196.15	242.64	144.03	143.88	29.61	1.12	0.20	26.43
3/20/2014 13:59	127.13	21.87	70.35	6.00	5.80	4.90	5.50	196.14	243.37	143.92	143.87	29.57	1.26	0.20	25.68
3/20/2014 14:00	127.13	21.86	70.40	6.00	5.80	4.90	5.50	196.08	242.78	143.93	143.83	29.54	1.18	0.20	25.15
3/20/2014 14:01	127.14	21.84	70.37	6.00	5.80	4.90	5.50	196.57	242.78	143.97	143.89	29.47	1.20	0.20	25.51
3/20/2014 14:02	127.13	21.76	70.31	6.00	5.80	4.90	5.50	196.48	242.78	143.92	144.06	29.49	1.18	0.20	26.81
3/20/2014 14:03	127.12	21.78	70.32	6.00	5.80	4.90	5.50	196.17	242.67	143.75	144.12	29.51	1.32	0.20	27.46
3/20/2014 14:04	127.12	21.82	70.35	6.00	5.80	4.90	5.50	196.11	242.50	143.83	144.28	29.58	1.17	0.20	26.79
3/20/2014 14:05	127.12	21.82	70.34	6.00	5.80	4.90	5.50	196.39	243.24	144.07	144.31	29.53	1.17	0.20	24.80
3/20/2014 14:06	127.12	21.82	70.27	6.00	5.80	4.90	5.50	196.18	243.38	144.03	144.39	29.47	1.19	0.20	24.57
3/20/2014 14:07	127.11	21.88	70.06	6.00	5.80	4.90	5.50	195.19	242.12	143.90	144.37	29.38	1.11	0.20	24.03
3/20/2014 14:08	127.11	22.05	69.90	6.00	5.80	4.90	5.50	195.16	241.65	143.94	144.31	29.38	1.19	0.20	24.86
3/20/2014 14:09	127.11	22.00	69.93	6.00	5.80	4.90	5.50	195.48	241.96	144.05	144.22	29.42	1.04	0.20	26.01
3/20/2014 14:10	127.11	21.84	70.09	6.00	5.80	4.90	5.50	194.92	240.87	144.02	143.96	29.53	1.30	0.20	26.10
3/20/2014 14:11	127.12	21.84	70.35	6.00	5.80	4.90	5.50	194.10	240.13	143.92	143.98	29.54	1.15	0.20	25.91
3/20/2014 14:12	127.12	21.83	70.49	6.00	5.80	4.90	5.50	194.50	240.69	144.00	144.04	29.56	1.01	0.20	24.05
3/20/2014 14:13	127.11	21.83	70.49	6.00	5.80	4.90	5.50	194.96	241.14	144.24	144.12	29.53	0.77	0.20	22.91
3/20/2014 14:14	127.11	21.83	70.34	6.00	5.80	4.90	5.50	195.19	241.16	144.22	144.37	29.56	0.94	0.20	23.05
3/20/2014 14:15	127.11	21.79	70.51	6.00	5.80	4.90	5.50	194.95	241.21	144.13	144.38	29.54	1.22	0.20	26.55
3/20/2014 14:16	127.11	21.69	70.71	6.00	5.80	4.90	5.50	195.28	241.63	144.12	144.44	29.57	1.07	0.20	25.66
3/20/2014 14:17	127.12	21.75	70.82	6.00	5.80	4.90	5.50	196.42	242.89	144.08	144.44	29.54	1.01	0.20	25.51
3/20/2014 14:18	127.12	21.95	70.81	6.00	5.80	4.90	5.50	196.01	242.84	144.03	144.43	29.48	1.17	0.20	25.05
3/20/2014 14:19	127.13	21.94	70.73	6.00	5.80	4.90	5.50	196.40	242.69	143.87	144.41	29.49	1.37	0.20	25.12
3/20/2014 14:20	127.13	21.91	70.70	6.00	5.80	4.90	5.50	195.49	242.33	143.88	144.34	29.50	1.32	0.20	25.34
3/20/2014 14:21	127.11	21.89	70.87	6.00	5.80	4.90	5.50	194.32	241.13	143.89	144.28	29.59	1.32	0.20	25.40
3/20/2014 14:22	127.11	21.82	70.81	6.00	5.80	4.90	5.50	195.06	241.28	143.93	144.06	29.57	1.25	0.20	25.60
3/20/2014 14:23	127.12	21.83	70.60	6.00	5.80	4.90	5.50	195.36	241.54	144.04	144.02	29.62	1.13	0.20	25.24
3/20/2014 14:24	127.12	21.87	70.48	6.00	5.80	4.90	5.50	194.84	240.88	144.06	143.90	29.60	1.15	0.20	24.22
3/20/2014 14:25	127.12	21.89	70.43	6.00	5.80	4.90	5.50	195.57	241.78	144.13	143.98	29.57	0.99	0.20	24.57
3/20/2014 14:26	127.12	21.95	70.24	6.00	5.80	4.90	5.50	196.17	242.31	144.14	144.23	29.42	0.93	0.20	24.15
3/20/2014 14:27	127.12	21.93	70.19	6.00	5.80	4.90	5.50	195.15	241.34	144.17	144.26	29.56	0.99	0.20	24.56
3/20/2014 14:28	127.12	21.85	70.36	6.00	5.80	4.90	5.50	195.37	241.40	144.17	144.36	29.54	1.03	0.20	24.32
3/20/2014 14:29	127.12	21.87	70.34	6.00	5.80	4.90	5.50	195.60	241.61	144.18	144.37	29.46	1.12	0.20	25.73
3/20/2014 14:30	127.12	21.93	70.33	6.00	5.80	4.90	5.50	195.52	241.58	144.16	144.40	29.43	1.32	0.20	25.15
3/20/2014 14:31	127.11	21.89	70.50	6.00	5.80	4.90	5.50	194.86	241.22	144.08	144.44	29.45	1.34	0.20	25.00
3/20/2014 14:32	127.11	21.79	70.58	6.00	5.80	4.90	5.50	194.37	240.75	144.11	144.58	29.53	1.23	0.20	24.54

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/20/2014 14:33															
Average	127.12	21.85	70.33	6.00	5.80	4.90	5.50	195.79	242.29	144.02	144.22	29.55	1.18	0.20	26.10

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/21/2014 8:23	127.20	18.04	69.88	6.00	3.10	3.40	5.40	202.66	250.48	144.07	143.97	29.51	1.24	0.20	25.50
3/21/2014 8:24	127.20	18.04	69.98	6.00	3.10	3.40	5.40	202.47	250.37	144.01	143.94	29.51	1.60	0.20	25.35
3/21/2014 8:25	127.20	18.04	70.14	6.00	3.10	3.40	5.40	201.68	249.77	143.83	143.84	29.61	1.74	0.19	24.97
3/21/2014 8:26	127.20	18.00	70.34	6.00	3.10	3.40	5.40	201.13	248.97	143.86	143.92	29.66	1.70	0.19	25.78
3/21/2014 8:27	127.20	17.89	70.40	6.00	3.10	3.40	5.40	201.37	248.93	143.96	144.18	29.71	1.32	0.20	26.69
3/21/2014 8:28	127.20	17.93	70.26	6.00	3.10	3.40	5.40	200.94	248.80	144.01	144.22	29.72	1.37	0.20	26.78
3/21/2014 8:29	127.19	18.08	69.99	6.00	3.10	3.40	5.40	201.19	248.90	144.19	144.35	29.65	1.31	0.20	26.74
3/21/2014 8:30	127.19	18.05	69.73	6.00	3.10	3.40	5.40	201.51	249.22	144.19	144.39	29.66	1.23	0.20	26.08
3/21/2014 8:31	127.19	17.98	69.57	6.00	3.10	3.40	5.40	201.71	249.23	144.22	144.51	29.58	1.11	0.20	26.80
3/21/2014 8:32	127.19	17.99	69.51	6.00	3.10	3.40	5.40	201.45	249.27	144.22	144.53	29.52	0.91	0.20	23.88
3/21/2014 8:33	127.19	18.04	69.52	6.00	3.10	3.40	5.40	201.84	249.43	144.24	144.60	29.49	0.86	0.19	23.29
3/21/2014 8:34	127.19	18.03	69.57	6.00	3.10	3.40	5.40	202.13	249.96	144.19	144.55	29.48	1.00	0.27	23.57
3/21/2014 8:35	127.20	18.00	69.65	6.00	3.10	3.40	5.40	202.04	249.86	144.03	144.38	29.47	1.43	0.51	25.13
3/21/2014 8:36	127.20	18.02	69.96	6.00	3.10	3.40	5.40	201.56	249.38	144.01	144.34	29.54	1.40	0.58	27.44
3/21/2014 8:37	127.20	18.10	70.20	6.00	3.10	3.40	5.40	201.15	248.96	143.95	144.21	29.55	1.45	0.83	27.91
3/21/2014 8:38	127.19	18.06	70.30	6.00	3.10	3.40	5.40	201.57	249.05	143.97	144.23	29.58	1.45	0.99	28.05
3/21/2014 8:39	127.18	17.95	70.18	6.00	3.10	3.40	5.40	201.27	249.16	144.07	144.30	29.61	1.50	1.24	28.84
3/21/2014 8:40	127.18	17.95	70.11	6.00	3.10	3.40	5.40	200.96	248.57	144.07	144.26	29.58	1.38	1.84	29.73
3/21/2014 8:41	127.19	17.94	69.89	6.00	3.10	3.40	5.40	200.93	248.57	144.05	144.15	29.56	1.25	1.71	29.35
3/21/2014 8:42	127.19	17.97	69.75	6.00	3.10	3.40	5.40	201.06	248.78	144.08	144.13	29.51	1.11	2.07	29.46
3/21/2014 8:43	127.19	18.08	69.53	6.00	3.10	3.40	5.40	201.87	249.52	144.19	144.05	29.55	1.09	2.21	28.54
3/21/2014 8:44	127.19	18.06	69.58	6.00	3.10	3.40	5.40	201.64	249.51	144.13	144.04	29.54	1.12	2.05	30.65
3/21/2014 8:45	127.19	18.01	69.79	6.00	3.10	3.40	5.40	201.42	249.47	143.93	144.03	29.63	1.30	2.25	30.54
3/21/2014 8:46	127.19	18.00	70.01	6.00	3.10	3.40	5.40	201.43	249.30	143.90	144.02	29.62	1.30	2.24	29.35
3/21/2014 8:47	127.18	18.00	70.19	6.00	3.10	3.40	5.40	200.77	248.62	143.79	143.99	29.56	1.39	2.19	31.58
3/21/2014 8:48	127.18	17.99	70.24	6.00	3.10	3.40	5.40	200.71	248.51	143.84	144.05	29.57	1.42	2.13	30.60
3/21/2014 8:49	127.19	17.97	70.13	6.00	3.10	3.40	5.40	201.22	249.41	144.00	144.24	29.59	1.24	2.28	30.84
3/21/2014 8:50	127.19	17.96	70.08	6.00	3.10	3.40	5.40	200.94	248.99	144.01	144.27	29.60	1.12	2.28	31.65
3/21/2014 8:51	127.20	17.93	70.10	6.00	3.10	3.40	5.40	201.52	248.93	144.05	144.36	29.62	1.14	2.30	31.55
3/21/2014 8:52	127.20	17.94	70.12	6.00	3.10	3.40	5.40	201.21	248.89	144.08	144.38	29.60	1.12	2.49	30.74
3/21/2014 8:53	127.20	17.97	69.99	6.00	3.10	3.40	5.40	201.00	249.41	144.18	144.48	29.54	1.07	2.74	29.76
3/21/2014 8:54	127.20	18.00	69.95	6.00	3.10	3.40	5.40	201.69	249.51	144.12	144.43	29.50	1.21	2.41	31.58
3/21/2014 8:55	127.19	18.08	69.98	6.00	3.10	3.40	5.40	201.66	249.82	143.92	144.25	29.46	1.40	2.09	32.49
3/21/2014 8:56	127.19	18.05	69.97	6.00	3.10	3.40	5.40	201.32	249.61	143.91	144.24	29.54	1.41	1.93	31.25
3/21/2014 8:57	127.19	17.96	70.25	6.00	3.10	3.40	5.40	200.71	249.08	143.88	144.21	29.63	1.49	1.48	30.95
3/21/2014 8:58	127.19	17.97	70.26	6.00	3.10	3.40	5.40	201.47	249.54	143.91	144.20	29.54	1.29	0.98	30.92
3/21/2014 8:59	127.19	17.99	70.06	6.00	3.10	3.40	5.40	201.88	249.57	144.02	144.17	29.49	1.31	1.65	27.55
3/21/2014 9:00	127.19	17.99	69.81	6.00	3.10	3.40	5.40	202.56	249.89	143.99	144.08	29.47	1.53	1.54	27.25
3/21/2014 9:01	127.20	18.00	69.62	6.00	3.10	3.40	5.40	201.77	250.06	143.89	143.79	29.49	1.81	0.81	28.15
3/21/2014 9:02	127.20	17.99	69.76	6.00	3.10	3.40	5.40	201.13	248.20	143.91	143.84	29.56	1.67	0.49	29.60
3/21/2014 9:03	127.20	17.93	69.91	6.00	3.10	3.40	5.40	200.73	248.41	143.99	144.02	29.65	1.43	0.43	30.78
3/21/2014 9:04	127.20	17.93	69.96	6.00	3.10	3.40	5.40	200.31	248.94	144.00	144.07	29.68	1.29	0.76	29.07
3/21/2014 9:05	127.20	17.93	69.73	6.00	3.10	3.40	5.40	200.23	248.36	144.04	144.24	29.60	1.18	0.96	28.06
3/21/2014 9:06	127.20	17.93	69.53	6.00	3.10	3.40	5.40	201.21	249.08	144.09	144.28	29.59	1.19	1.11	27.35
3/21/2014 9:07	127.20	17.95	69.52	6.00	3.10	3.40	5.40	201.18	249.09	144.24	144.42	29.55	1.09	1.05	28.64
3/21/2014 9:08	127.20	17.94	69.53	6.00	3.10	3.40	5.40	200.96	249.13	144.19	144.40	29.59	1.19	1.30	26.69
3/21/2014 9:09	127.20	17.91	69.77	6.00	3.10	3.40	5.40	200.61	249.14	144.00	144.36	29.64	1.42	0.89	28.91
3/21/2014 9:10	127.20	17.94	69.95	6.00	3.10	3.40	5.40	200.93	249.04	144.01	144.34	29.63	1.33	0.57	30.23
3/21/2014 9:11	127.21	18.05	69.97	6.00	3.10	3.40	5.40	200.88	248.53	144.04	144.29	29.53	1.47	0.48	29.41
3/21/2014 9:12	127.21	18.03	69.89	6.00	3.10	3.40	5.40	201.39	248.75	144.05	144.32	29.53	1.53	0.37	29.66
3/21/2014 9:13	127.20	17.95	70.04	6.00	3.10	3.40	5.40	201.43	249.46	144.09	144.43	29.55	1.55	0.46	27.40
3/21/2014 9:14	127.20	17.98	69.96	6.00	3.10	3.40	5.40	200.96	249.34	144.11	144.47	29.59	1.46	0.53	28.43
3/21/2014 9:15	127.19	18.08	69.83	6.00	3.10	3.40	5.40	200.17	248.56	144.16	144.59	29.53	1.41	0.88	28.16
3/21/2014 9:16	127.19	18.09	69.81	6.00	3.10	3.40	5.40	199.82	247.34	144.18	144.55	29.65	1.24	0.69	30.12
3/21/2014 9:17	127.19	18.10	69.89	6.00	3.10	3.40	5.40	199.77	247.73	144.22	144.42	29.64	1.22	0.57	29.69
3/21/2014 9:18	127.19	18.09	69.71	6.00	3.10	3.40	5.40	199.97	247.56	144.22	144.37	29.60	1.15	0.61	28.83
3/21/2014 9:19	127.20	18.05	69.71	6.00	3.10	3.40	5.40	200.06	247.16	144.20	144.18	29.56	1.12	0.56	29.73
3/21/2014 9:20	127.20	18.05	69.73	6.00	3.10	3.40	5.40	200.46	247.88	144.12	144.12	29.55	1.29	0.93	27.67
3/21/2014 9:21	127.20	18.05	69.88	6.00	3.10	3.40	5.40	200.54	248.50	143.88	143.94	29.57	1.29	0.46	29.68
3/21/2014 9:22	127.20	18.05	69.99	6.00	3.10	3.40	5.40	199.99	248.50	143.90	144.01	29.55	1.40	0.83	28.33
3/21/2014 9:23	127.20	18.03	70.04	6.00	3.10	3.40	5.40	200.38	248.28	143.96	144.25	29.49	1.19	0.96	29.62
3/21/2014 9:24	127.20	18.05	69.95	6.00	3.10	3.40	5.40	200.36	247.64	143.97	144.26	29.48	1.23	0.90	27.43
3/21/2014 9:25	127.19	18.11	69.88	6.00	3.10	3.40	5.40	201.06	247.98	144.00	144.30	29.52	1.19	0.71	28.12
3/21/2014 9:26	127.19	18.08	69.80	6.00	3.10	3.40	5.40	200.10	247.55	143.98	144.28	29.47	1.15	0.80	27.26
3/21/2014 9:27	127.19	17.96	69.88	6.00	3.10	3.40	5.40	199.90	247.51	143.93	144.24	29.47	1.37	1.06	29.02
3/21/2014 9:28	127.19	17.95	69.92	6.00	3.10	3.40	5.40	200.44	247.36	143.99	144.29	29.47	1.25	0.94	29.39
3/21/2014 9:29	127.19	17.93	69.90	6.00	3.10	3.40	5.40	200.17	247.62	144.18	144.45	29.46	1.19	0.95	28.41

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/21/2014 9:30	127.19	17.96	69.81	6.00	3.10	3.40	5.40	200.16	248.26	144.13	144.41	29.43	1.25	1.26	27.15
3/21/2014 9:31	127.17	18.06	69.83	6.00	3.10	3.40	5.40	199.81	247.11	143.97	144.29	29.52	1.49	0.48	29.46
3/21/2014 9:32	127.18	18.05	70.06	6.00	3.10	3.40	5.40	199.67	247.09	144.00	144.32	29.55	1.44	0.66	28.28
3/21/2014 9:33															
Average	127.19	18.00	69.91	6.00	3.10	3.40	5.40	201.03	248.83	144.04	144.24	29.56	1.31	1.06	28.54

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/21/14 8:34	127.19	18.03	69.57	6.00	3.10	3.40	5.40	202.13	249.96	144.19	144.55	29.48	1.00	0.27	23.57
3/21/14 8:35	127.20	18.00	69.65	6.00	3.10	3.40	5.40	202.04	249.86	144.03	144.38	29.47	1.43	0.51	25.13
3/21/14 8:36	127.20	18.02	69.96	6.00	3.10	3.40	5.40	201.56	249.38	144.01	144.34	29.54	1.40	0.58	27.44
3/21/14 8:37	127.20	18.10	70.20	6.00	3.10	3.40	5.40	201.15	248.96	143.95	144.21	29.55	1.45	0.83	27.91
3/21/14 8:38	127.19	18.06	70.30	6.00	3.10	3.40	5.40	201.57	249.05	143.97	144.23	29.58	1.45	0.99	28.05
3/21/14 8:39	127.18	17.95	70.18	6.00	3.10	3.40	5.40	201.27	249.16	144.07	144.30	29.61	1.50	1.24	28.84
3/21/14 8:40	127.18	17.95	70.11	6.00	3.10	3.40	5.40	200.96	248.57	144.07	144.26	29.58	1.38	1.84	29.73
3/21/14 8:41	127.19	17.94	69.89	6.00	3.10	3.40	5.40	200.93	248.57	144.05	144.15	29.56	1.25	1.71	29.35
3/21/14 8:42	127.19	17.97	69.75	6.00	3.10	3.40	5.40	201.06	248.78	144.08	144.13	29.51	1.11	2.07	29.46
3/21/14 8:43	127.19	18.08	69.53	6.00	3.10	3.40	5.40	201.87	249.52	144.19	144.05	29.55	1.09	2.21	28.54
3/21/14 8:44	127.19	18.06	69.58	6.00	3.10	3.40	5.40	201.64	249.51	144.13	144.04	29.54	1.12	2.05	30.65
3/21/14 8:45	127.19	18.01	69.79	6.00	3.10	3.40	5.40	201.42	249.47	143.93	144.03	29.63	1.30	2.25	30.54
3/21/14 8:46	127.19	18.00	70.01	6.00	3.10	3.40	5.40	201.43	249.30	143.90	144.02	29.62	1.30	2.24	29.35
3/21/14 8:47	127.18	18.00	70.19	6.00	3.10	3.40	5.40	200.77	248.62	143.79	143.99	29.56	1.39	2.19	31.58
3/21/14 8:48	127.18	17.99	70.24	6.00	3.10	3.40	5.40	200.71	248.51	143.84	144.05	29.57	1.42	2.13	30.60
3/21/14 8:49	127.19	17.97	70.13	6.00	3.10	3.40	5.40	201.22	249.41	144.00	144.24	29.59	1.24	2.28	30.84
3/21/14 8:50	127.19	17.96	70.08	6.00	3.10	3.40	5.40	200.94	248.99	144.01	144.27	29.60	1.12	2.28	31.65
3/21/14 8:51	127.20	17.93	70.10	6.00	3.10	3.40	5.40	201.52	248.93	144.05	144.36	29.62	1.14	2.30	31.55
3/21/14 8:52	127.20	17.94	70.12	6.00	3.10	3.40	5.40	201.21	248.89	144.08	144.38	29.60	1.12	2.49	30.74
3/21/14 8:53	127.20	17.97	69.99	6.00	3.10	3.40	5.40	201.00	249.41	144.18	144.48	29.54	1.07	2.74	29.76
3/21/14 8:54	127.20	18.00	69.95	6.00	3.10	3.40	5.40	201.69	249.51	144.12	144.43	29.50	1.21	2.41	31.58
3/21/14 8:55	127.19	18.08	69.98	6.00	3.10	3.40	5.40	201.66	249.82	143.92	144.25	29.46	1.40	2.09	32.49
3/21/14 8:56	127.19	18.05	69.97	6.00	3.10	3.40	5.40	201.32	249.61	143.91	144.24	29.54	1.41	1.93	31.25
3/21/14 8:57	127.19	17.96	70.25	6.00	3.10	3.40	5.40	200.71	249.08	143.88	144.21	29.63	1.49	1.48	30.95
3/21/14 8:58	127.19	17.97	70.26	6.00	3.10	3.40	5.40	201.47	249.54	143.91	144.20	29.54	1.29	0.98	30.92
3/21/14 8:59	127.19	17.99	70.06	6.00	3.10	3.40	5.40	201.88	249.57	144.02	144.17	29.49	1.31	1.65	27.55
3/21/14 9:00	127.19	17.99	69.81	6.00	3.10	3.40	5.40	202.56	249.89	143.99	144.08	29.47	1.53	1.54	27.25
3/21/14 9:01	127.20	18.00	69.62	6.00	3.10	3.40	5.40	201.77	250.06	143.89	143.79	29.49	1.81	0.81	28.15
3/21/14 9:02	127.20	17.99	69.76	6.00	3.10	3.40	5.40	201.13	248.20	143.91	143.84	29.56	1.67	0.49	29.60
3/21/14 9:03	127.20	17.93	69.91	6.00	3.10	3.40	5.40	200.73	248.41	143.99	144.02	29.65	1.43	0.43	30.78
3/21/14 9:04	127.20	17.93	69.96	6.00	3.10	3.40	5.40	200.31	248.94	144.00	144.07	29.68	1.29	0.76	29.07
3/21/14 9:05	127.20	17.93	69.73	6.00	3.10	3.40	5.40	200.23	248.36	144.04	144.24	29.60	1.18	0.96	28.06
3/21/14 9:06	127.20	17.93	69.53	6.00	3.10	3.40	5.40	201.21	249.08	144.09	144.28	29.59	1.19	1.11	27.35
3/21/14 9:07	127.20	17.95	69.52	6.00	3.10	3.40	5.40	201.18	249.09	144.24	144.42	29.55	1.09	1.05	28.64
3/21/14 9:08	127.20	17.94	69.53	6.00	3.10	3.40	5.40	200.96	249.13	144.19	144.40	29.59	1.19	1.30	26.69
3/21/14 9:09	127.20	17.91	69.77	6.00	3.10	3.40	5.40	200.61	249.14	144.00	144.36	29.64	1.42	0.89	28.91
3/21/14 9:10	127.20	17.94	69.95	6.00	3.10	3.40	5.40	200.93	249.04	144.01	144.34	29.63	1.33	0.57	30.23
3/21/14 9:11	127.21	18.05	69.97	6.00	3.10	3.40	5.40	200.88	248.53	144.04	144.29	29.53	1.47	0.48	29.41
3/21/14 9:12	127.21	18.03	69.89	6.00	3.10	3.40	5.40	201.39	248.75	144.05	144.32	29.53	1.53	0.37	29.66
3/21/14 9:13	127.20	17.95	70.04	6.00	3.10	3.40	5.40	201.43	249.46	144.09	144.43	29.55	1.55	0.46	27.40
3/21/14 9:14	127.20	17.98	69.96	6.00	3.10	3.40	5.40	200.96	249.34	144.11	144.47	29.59	1.46	0.53	28.43
3/21/14 9:15	127.19	18.08	69.83	6.00	3.10	3.40	5.40	200.17	248.56	144.16	144.59	29.53	1.41	0.88	28.16
3/21/14 9:16	127.19	18.09	69.81	6.00	3.10	3.40	5.40	199.82	247.34	144.18	144.55	29.65	1.24	0.69	30.12
3/21/14 9:17	127.19	18.10	69.89	6.00	3.10	3.40	5.40	199.77	247.73	144.22	144.42	29.64	1.22	0.57	29.69
3/21/14 9:18	127.19	18.09	69.71	6.00	3.10	3.40	5.40	199.97	247.56	144.22	144.37	29.60	1.15	0.61	28.83
3/21/14 9:19	127.20	18.05	69.71	6.00	3.10	3.40	5.40	200.06	247.16	144.20	144.18	29.56	1.12	0.56	29.73
3/21/14 9:20	127.20	18.05	69.73	6.00	3.10	3.40	5.40	200.46	247.88	144.12	144.12	29.55	1.29	0.93	27.67
3/21/14 9:21	127.20	18.05	69.88	6.00	3.10	3.40	5.40	200.54	248.50	143.88	143.94	29.57	1.29	0.46	29.68
3/21/14 9:22	127.20	18.05	69.99	6.00	3.10	3.40	5.40	199.99	248.50	143.90	144.01	29.55	1.40	0.83	28.33
3/21/14 9:23	127.20	18.03	70.04	6.00	3.10	3.40	5.40	200.38	248.28	143.96	144.25	29.49	1.19	0.96	29.62
3/21/14 9:24	127.20	18.05	69.95	6.00	3.10	3.40	5.40	200.36	247.64	143.97	144.26	29.48	1.23	0.90	27.43
3/21/14 9:25	127.19	18.11	69.88	6.00	3.10	3.40	5.40	201.06	247.98	144.00	144.30	29.52	1.19	0.71	28.12
3/21/14 9:26	127.19	18.08	69.80	6.00	3.10	3.40	5.40	200.10	247.55	143.98	144.28	29.47	1.15	0.80	27.26
3/21/14 9:27	127.19	17.96	69.88	6.00	3.10	3.40	5.40	199.90	247.51	143.93	144.24	29.47	1.37	1.06	29.02
3/21/14 9:28	127.19	17.95	69.92	6.00	3.10	3.40	5.40	200.44	247.36	143.99	144.29	29.47	1.25	0.94	29.39
3/21/14 9:29	127.19	17.93	69.90	6.00	3.10	3.40	5.40	200.17	247.62	144.18	144.45	29.46	1.19	0.95	28.41
3/21/14 9:30	127.19	17.96	69.81	6.00	3.10	3.40	5.40	200.16	248.26	144.13	144.41	29.43	1.25	1.26	27.15
3/21/14 9:31	127.17	18.06	69.83	6.00	3.10	3.40	5.40	199.81	247.11	143.97	144.29	29.52	1.49	0.48	29.46
3/21/14 9:32	127.18	18.05	70.06	6.00	3.10	3.40	5.40	199.67	247.09	144.00	144.32	29.55	1.44	0.66	28.18
3/21/14 9:33	127.19	18.04	70.09	6.00	3.10	3.40	5.40	199.39	247.12	144.07	144.43	29.56	1.32	0.25	27.53
3/21/14 9:34	127.20	18.06	70.20	6.00	3.10	3.40	5.40	199.79	247.30	144.08	144.39	29.58	1.29	0.20	29.03
3/21/14 9:35	127.21	18.11	70.14	6.00	3.10	3.40	5.40	199.29	246.74	144.09	144.30	29.54	1.19	0.21	27.97
3/21/14 9:36	127.21	18.11	69.96	6.00	3.10	3.40	5.40	199.87	247.16	144.15	144.28	29.57	1.04	0.29	27.70
3/21/14 9:37	127.20	18.10	69.93	6.00	3.10	3.40	5.40	200.37	247.37	144.31	144.20	29.52	0.96	0.42	26.82
3/21/14 9:38	127.20	18.12	69.80	6.00	3.10	3.40	5.40	200.55	248.04	144.27	144.16	29.48	0.96	0.23	26.30
3/21/14 9:39	127.20	18.18	69.73	6.00	3.10	3.40	5.40	200.69	248.22	144.17	144.06	29.38	1.06	0.29	24.82
3/21/14 9:40	127.20	18.11	69.89	6.00	3.10	3.40	5.40	200.40	248.45	144.13	144.08	29.48	1.23	0.20	26.46

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min *25C3147V*	FLUE GAS STK TMP deg F *30TI6008*	FLUE GAS SCRUBBR STK TMP deg F *30TI1807*	Dry Flue Gas Rate MMOL/H *25F3147D*	SCRUBBER STACK O2 % *30AI6014*	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/21/14 9:41	127.19	17.85	70.15	6.00	3.10	3.40	5.40	199.86	246.93	144.03	144.17	29.53	1.36	0.20	27.25
3/21/14 9:42	127.20	17.89	70.32	6.00	3.10	3.40	5.40	199.28	246.92	144.07	144.23	29.55	1.19	0.20	27.73
3/21/14 9:43	127.20	18.03	70.48	6.00	3.10	3.40	5.40	199.12	246.89	144.18	144.41	29.60	1.23	0.20	26.50
3/21/14 9:44	127.20	18.04	70.56	6.00	3.10	3.40	5.40	199.02	246.95	144.24	144.47	29.57	1.19	0.20	26.36
3/21/14 9:45	127.19	18.09	70.29	6.00	3.10	3.40	5.40	199.96	247.49	144.41	144.63	29.46	1.11	0.20	25.48
3/21/14 9:46	127.19	18.08	69.97	6.00	3.10	3.40	5.40	200.67	248.42	144.36	144.62	29.44	1.19	0.22	24.76
3/21/14 9:47	127.19	18.03	70.03	6.00	3.10	3.40	5.40	199.88	247.77	144.23	144.59	29.51	1.41	0.22	27.38
3/21/14 9:48	127.19	18.00	70.28	6.00	3.10	3.40	5.40	199.95	248.33	144.26	144.63	29.58	1.22	0.20	27.81
3/21/14 9:49	127.18	17.90	70.41	6.00	3.10	3.40	5.40	199.73	247.53	144.34	144.75	29.60	1.19	0.20	27.19
3/21/14 9:50	127.19	17.90	70.51	6.00	3.10	3.40	5.40	199.61	247.17	144.35	144.71	29.67	1.36	0.20	28.32
3/21/14 9:51	127.19	17.92	70.49	6.00	3.10	3.40	5.40	199.32	246.15	144.35	144.59	29.64	1.22	0.20	28.09
3/21/14 9:52	127.19	17.95	70.37	6.00	3.10	3.40	5.40	199.56	246.49	144.38	144.58	29.65	1.26	0.20	26.98
3/21/14 9:53	127.20	18.05	70.25	6.00	3.10	3.40	5.40	199.08	246.05	144.48	144.53	29.60	1.14	0.20	26.67
3/21/14 9:54	127.20	18.04	70.12	6.00	3.10	3.40	5.40	199.86	246.87	144.51	144.55	29.60	1.19	0.20	27.78
3/21/14 9:55															
Average	127.19	18.01	69.98	6.00	3.10	3.40	5.40	200.61	248.34	144.09	144.30	29.55	1.28	0.95	28.53

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/21/2014 10:06	127.19	18.03	70.23	6.00	3.10	3.40	5.40	198.86	246.40	144.93	145.16	29.48	1.11	0.20	24.50
3/21/2014 10:07	127.19	18.07	70.20	6.00	3.10	3.40	5.40	198.95	245.92	144.80	144.78	29.46	1.19	0.20	24.33
3/21/2014 10:08	127.19	18.08	70.22	6.00	3.10	3.40	5.40	199.19	246.51	144.73	144.73	29.48	1.09	0.20	24.84
3/21/2014 10:09	127.20	18.10	70.36	6.00	3.10	3.40	5.40	198.82	246.40	144.52	144.58	29.57	1.16	0.20	24.06
3/21/2014 10:10	127.19	18.06	70.55	6.00	3.10	3.40	5.40	198.66	246.00	144.54	144.61	29.58	1.33	0.20	26.80
3/21/2014 10:11	127.19	17.94	70.51	6.00	3.10	3.40	5.40	198.71	245.99	144.59	144.70	29.51	1.12	0.20	25.47
3/21/2014 10:12	127.19	17.97	70.32	6.00	3.10	3.40	5.40	198.70	245.78	144.56	144.69	29.46	1.12	0.20	26.43
3/21/2014 10:13	127.19	18.05	70.21	6.00	3.10	3.40	5.40	198.04	245.13	144.48	144.69	29.45	1.12	0.20	26.40
3/21/2014 10:14	127.19	18.05	70.17	6.00	3.10	3.40	5.40	198.27	245.42	144.47	144.75	29.42	1.06	0.20	25.66
3/21/2014 10:15	127.20	18.07	70.00	6.00	3.10	3.40	5.40	199.17	246.38	144.46	144.86	29.36	1.06	0.20	24.21
3/21/2014 10:16	127.19	18.12	69.87	6.00	3.10	3.40	5.40	199.79	246.60	144.43	144.66	29.31	1.18	0.20	26.15
3/21/2014 10:17	127.18	18.28	69.91	6.00	3.10	3.40	5.40	200.17	247.32	144.35	144.63	29.32	1.19	0.20	25.44
3/21/2014 10:18	127.18	18.20	70.10	6.00	3.10	3.40	5.40	199.44	246.95	144.31	144.52	29.38	1.36	0.20	25.25
3/21/2014 10:19	127.18	17.93	70.27	6.00	3.10	3.40	5.40	198.16	245.12	144.19	144.51	29.47	1.21	0.20	25.16
3/21/2014 10:20	127.18	17.95	70.26	6.00	3.10	3.40	5.40	197.26	243.71	144.22	144.47	29.46	1.19	0.20	26.90
3/21/2014 10:21	127.18	18.03	70.22	6.00	3.10	3.40	5.40	197.90	244.57	144.31	144.44	29.44	1.23	0.20	25.20
3/21/2014 10:22	127.18	18.02	70.15	6.00	3.10	3.40	5.40	197.81	244.04	144.30	144.32	29.45	1.11	0.20	24.29
3/21/2014 10:23	127.18	17.99	69.95	6.00	3.10	3.40	5.40	197.46	243.96	144.28	144.30	29.50	1.07	0.20	25.01
3/21/2014 10:24	127.18	18.03	70.02	6.00	3.10	3.40	5.40	197.17	243.72	144.32	144.33	29.50	1.05	0.20	24.22
3/21/2014 10:25	127.18	18.18	69.97	6.00	3.10	3.40	5.40	197.14	244.14	144.46	144.62	29.39	0.98	0.20	24.36
3/21/2014 10:26	127.18	18.15	69.83	6.00	3.10	3.40	5.40	198.03	245.32	144.44	144.61	29.40	0.95	0.20	24.83
3/21/2014 10:27	127.18	18.02	69.98	6.00	3.10	3.40	5.40	198.01	244.86	144.38	144.68	29.43	1.13	0.20	24.25
3/21/2014 10:28	127.18	18.05	70.09	6.00	3.10	3.40	5.40	198.51	245.52	144.42	144.91	29.47	1.05	0.20	22.14
3/21/2014 10:29	127.19	18.16	70.15	6.00	3.10	3.40	5.40	198.56	245.63	144.55	144.89	29.45	0.94	0.20	22.46
3/21/2014 10:30	127.19	18.10	70.40	6.00	3.10	3.40	5.40	198.76	246.23	144.49	144.84	29.58	0.95	0.20	24.14
3/21/2014 10:31	127.19	17.91	70.58	6.00	3.10	3.40	5.40	198.78	246.49	144.30	144.80	29.56	1.12	0.20	25.79
3/21/2014 10:32	127.19	17.90	70.71	6.00	3.10	3.40	5.40	199.00	245.07	144.28	144.59	29.57	1.24	0.20	25.88
3/21/2014 10:33	127.19	17.86	70.88	6.00	3.10	3.40	5.40	199.39	245.76	144.22	144.36	29.64	1.33	0.20	26.21
3/21/2014 10:34	127.18	17.88	70.94	6.00	3.10	3.40	5.40	198.50	245.29	144.22	144.32	29.69	1.30	0.28	26.56
3/21/2014 10:35	127.16	17.96	70.93	6.00	3.10	3.40	5.40	196.74	243.71	144.32	144.21	29.70	1.17	0.65	27.71
3/21/2014 10:36	127.17	17.95	70.83	6.00	3.10	3.40	5.40	196.75	243.72	144.53	144.29	29.72	0.93	1.22	27.09
3/21/2014 10:37	127.18	17.90	70.58	6.00	3.10	3.40	5.40	197.08	244.08	144.50	144.51	29.56	0.91	1.60	25.19
3/21/2014 10:38	127.18	17.94	70.24	6.00	3.10	3.40	5.40	198.14	245.07	144.39	144.49	29.43	1.09	1.49	26.89
3/21/2014 10:39	127.19	18.10	70.05	6.00	3.10	3.40	5.40	197.95	244.77	144.35	144.44	29.39	1.10	1.35	28.19
3/21/2014 10:40	127.18	18.10	70.10	6.00	3.10	3.40	5.40	198.30	245.59	144.22	144.48	29.40	1.25	1.29	28.80
3/21/2014 10:41	127.18	18.09	70.29	6.00	3.10	3.40	5.40	198.02	245.45	144.24	144.59	29.45	1.09	1.53	30.48
3/21/2014 10:42	127.18	18.04	70.38	6.00	3.10	3.40	5.40	197.69	244.95	144.33	144.59	29.49	1.10	1.79	29.17
3/21/2014 10:43	127.19	17.95	70.48	6.00	3.10	3.40	5.40	197.43	244.82	144.35	144.62	29.54	0.98	1.93	28.78
3/21/2014 10:44	127.19	18.16	70.44	6.00	3.10	3.40	5.40	196.68	244.36	144.43	144.65	29.48	0.92	1.75	29.43
3/21/2014 10:45	127.19	18.13	70.36	6.00	3.10	3.40	5.40	197.45	244.26	144.43	144.78	29.47	0.99	2.28	28.39
3/21/2014 10:46	127.18	18.05	70.49	6.00	3.10	3.40	5.40	197.48	243.91	144.45	144.79	29.55	0.93	2.14	28.99
3/21/2014 10:47	127.18	18.03	70.61	6.00	3.10	3.40	5.40	197.30	243.97	144.47	144.84	29.58	0.92	2.34	28.82
3/21/2014 10:48	127.17	17.95	70.73	6.00	3.10	3.40	5.40	196.62	244.01	144.56	144.84	29.54	0.89	2.35	27.99
3/21/2014 10:49	127.17	17.99	70.67	6.00	3.10	3.40	5.40	197.14	243.92	144.58	144.86	29.40	0.80	2.70	26.90
3/21/2014 10:50	127.17	18.13	70.44	6.00	3.10	3.40	5.40	198.13	245.40	144.63	144.78	29.32	0.89	2.81	26.36
3/21/2014 10:51	127.18	18.16	70.31	6.00	3.10	3.40	5.40	199.20	246.24	144.55	144.50	29.31	0.99	2.51	27.92
3/21/2014 10:52	127.17	18.24	70.44	6.00	3.10	3.40	5.40	198.90	245.68	144.29	144.46	29.32	1.26	2.40	28.39
3/21/2014 10:53	127.16	18.17	70.66	6.00	3.10	3.40	5.40	199.09	246.33	144.34	144.36	29.46	1.16	2.51	28.69
3/21/2014 10:54	127.16	17.96	70.98	6.00	3.10	3.40	5.40	198.47	245.51	144.48	144.43	29.54	1.14	2.09	29.86
3/21/2014 10:55	127.16	17.97	71.02	6.00	3.10	3.40	5.40	198.34	245.43	144.50	144.68	29.51	1.29	1.51	30.02
3/21/2014 10:56	127.16	17.98	70.84	6.00	3.10	3.40	5.40	198.52	245.45	144.55	144.73	29.53	1.18	1.30	28.45
3/21/2014 10:57	127.15	18.01	70.75	6.00	3.10	3.40	5.40	198.77	245.88	144.57	144.88	29.59	1.24	1.25	28.42
3/21/2014 10:58	127.15	18.09	70.78	6.00	3.10	3.40	5.40	197.58	244.14	144.62	144.92	29.63	1.24	1.35	28.32
3/21/2014 10:59	127.13	18.07	70.68	6.00	3.10	3.40	5.40	197.40	244.29	144.60	145.05	29.63	1.26	0.96	28.39
3/21/2014 11:00	127.14	17.99	70.65	6.00	3.10	3.40	5.40	197.56	244.80	144.54	145.08	29.62	1.13	0.58	28.61
3/21/2014 11:01	127.15	17.99	70.52	6.00	3.10	3.40	5.40	197.39	244.48	144.57	145.19	29.58	1.08	0.71	28.18
3/21/2014 11:02	127.16	18.02	70.34	6.00	3.10	3.40	5.40	196.15	243.45	144.68	145.16	29.49	1.15	0.83	26.89
3/21/2014 11:03	127.16	18.04	70.12	6.00	3.10	3.40	5.40	196.36	243.42	144.70	144.99	29.43	1.07	0.64	27.33
3/21/2014 11:04	127.16	18.09	69.97	6.00	3.10	3.40	5.40	196.84	243.43	144.76	144.78	29.41	1.12	0.74	27.02
3/21/2014 11:05	127.17	18.09	70.02	6.00	3.10	3.40	5.40	197.35	243.61	144.74	144.73	29.46	1.18	0.49	26.73
3/21/2014 11:06	127.17	18.08	70.23	6.00	3.10	3.40	5.40	196.71	242.81	144.68	144.55	29.50	1.40	0.36	28.93
3/21/2014 11:07	127.16	18.05	70.39	6.00	3.10	3.40	5.40	196.15	242.76	144.71	144.63	29.51	1.43	0.65	27.92
3/21/2014 11:08	127.16	17.97	70.32	6.00	3.10	3.40	5.40	196.23	242.60	144.80	144.89	29.45	1.21	0.30	26.73
3/21/2014 11:09	127.16	17.97	70.18	6.00	3.10	3.40	5.40	196.34	242.90	144.82	144.94	29.41	1.12	0.60	27.97
3/21/2014 11:10	127.16	17.97	69.93	6.00	3.10	3.40	5.40	197.34	244.00	144.88	145.10	29.36	1.21	0.82	27.39
3/21/2014 11:11	127.16	17.99	69.90	6.00	3.10	3.40	5.40	197.78	244.31	144.84	145.10	29.48	1.30	0.40	27.78
3/21/2014 11:12															

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS *SCRUBBR STK* TMP deg F 30TI1807	*Dry Flue Gas* Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED *NOX* ppm 30AI6012
Average	127.18	18.04	70.36	6.00	3.10	3.40	5.40	197.95	244.91	144.49	144.69	29.49	1.12	0.88	26.76

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3S32L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMDL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI5012
3/21/2014 10:30	127.19	18.10	70.40	6.00	3.10	3.40	5.40	198.76	246.23	144.49	144.84	29.58	0.95	0.20	24.14
3/21/2014 10:31	127.19	17.91	70.58	6.00	3.10	3.40	5.40	198.78	246.49	144.30	144.80	29.56	1.12	0.20	25.79
3/21/2014 10:32	127.19	17.90	70.71	6.00	3.10	3.40	5.40	199.00	245.07	144.28	144.59	29.57	1.24	0.20	25.88
3/21/2014 10:33	127.19	17.86	70.88	6.00	3.10	3.40	5.40	199.39	245.76	144.22	144.36	29.64	1.33	0.20	26.21
3/21/2014 10:34	127.18	17.88	70.94	6.00	3.10	3.40	5.40	198.50	245.29	144.22	144.32	29.69	1.30	0.28	26.56
3/21/2014 10:35	127.16	17.96	70.93	6.00	3.10	3.40	5.40	196.74	243.71	144.32	144.21	29.70	1.17	0.65	27.71
3/21/2014 10:36	127.17	17.95	70.83	6.00	3.10	3.40	5.40	196.75	243.72	144.53	144.29	29.72	0.93	1.22	27.09
3/21/2014 10:37	127.18	17.90	70.58	6.00	3.10	3.40	5.40	197.08	244.08	144.50	144.51	29.56	0.91	1.60	25.19
3/21/2014 10:38	127.18	17.94	70.24	6.00	3.10	3.40	5.40	198.14	245.07	144.39	144.49	29.43	1.09	1.49	26.89
3/21/2014 10:39	127.19	18.10	70.05	6.00	3.10	3.40	5.40	197.95	244.77	144.35	144.44	29.39	1.10	1.35	28.19
3/21/2014 10:40	127.18	18.10	70.10	6.00	3.10	3.40	5.40	198.30	245.59	144.22	144.48	29.40	1.25	1.29	28.80
3/21/2014 10:41	127.18	18.09	70.29	6.00	3.10	3.40	5.40	198.02	245.45	144.24	144.59	29.45	1.09	1.53	30.48
3/21/2014 10:42	127.18	18.04	70.38	6.00	3.10	3.40	5.40	197.69	244.95	144.33	144.59	29.49	1.10	1.79	29.17
3/21/2014 10:43	127.19	17.95	70.48	6.00	3.10	3.40	5.40	197.43	244.82	144.35	144.62	29.54	0.98	1.93	28.78
3/21/2014 10:44	127.19	18.16	70.44	6.00	3.10	3.40	5.40	196.68	244.36	144.43	144.66	29.48	0.92	1.75	29.43
3/21/2014 10:45	127.19	18.13	70.36	6.00	3.10	3.40	5.40	197.45	244.26	144.43	144.78	29.47	0.99	2.28	28.39
3/21/2014 10:46	127.18	18.05	70.49	6.00	3.10	3.40	5.40	197.48	243.91	144.45	144.79	29.55	0.93	2.14	28.99
3/21/2014 10:47	127.18	18.03	70.61	6.00	3.10	3.40	5.40	197.30	243.97	144.47	144.84	29.58	0.92	2.34	28.82
3/21/2014 10:48	127.17	17.95	70.73	6.00	3.10	3.40	5.40	196.62	244.01	144.56	144.84	29.54	0.89	2.35	27.99
3/21/2014 10:49	127.17	17.99	70.67	6.00	3.10	3.40	5.40	197.14	243.92	144.58	144.86	29.40	0.80	2.70	26.90
3/21/2014 10:50	127.17	18.13	70.44	6.00	3.10	3.40	5.40	198.13	245.40	144.63	144.78	29.32	0.89	2.81	26.36
3/21/2014 10:51	127.18	18.16	70.31	6.00	3.10	3.40	5.40	199.20	246.24	144.55	144.50	29.31	0.99	2.51	27.92
3/21/2014 10:52	127.17	18.24	70.44	6.00	3.10	3.40	5.40	198.90	245.68	144.29	144.46	29.32	1.26	2.40	28.39
3/21/2014 10:53	127.16	18.17	70.66	6.00	3.10	3.40	5.40	199.09	246.33	144.34	144.36	29.46	1.16	2.51	28.69
3/21/2014 10:54	127.16	17.96	70.98	6.00	3.10	3.40	5.40	198.47	245.51	144.48	144.43	29.54	1.14	2.09	29.86
3/21/2014 10:55	127.16	17.97	71.02	6.00	3.10	3.40	5.40	198.34	245.43	144.50	144.68	29.51	1.29	1.51	30.02
3/21/2014 10:56	127.16	17.98	70.84	6.00	3.10	3.40	5.40	198.52	245.45	144.55	144.73	29.53	1.18	1.30	29.45
3/21/2014 10:57	127.15	18.01	70.75	6.00	3.10	3.40	5.40	198.77	245.88	144.57	144.88	29.59	1.24	1.25	28.42
3/21/2014 10:58	127.15	18.09	70.78	6.00	3.10	3.40	5.40	197.58	244.14	144.62	144.92	29.63	1.24	1.35	28.32
3/21/2014 10:59	127.13	18.07	70.68	6.00	3.10	3.40	5.40	197.40	244.29	144.60	145.05	29.63	1.26	0.96	28.39
3/21/2014 11:00	127.14	17.99	70.65	6.00	3.10	3.40	5.40	197.56	244.80	144.54	145.08	29.62	1.13	0.58	28.61
3/21/2014 11:01	127.15	17.99	70.52	6.00	3.10	3.40	5.40	197.39	244.48	144.57	145.19	29.58	1.08	0.71	28.18
3/21/2014 11:02	127.16	18.02	70.34	6.00	3.10	3.40	5.40	196.15	243.45	144.68	145.16	29.49	1.15	0.83	26.89
3/21/2014 11:03	127.16	18.04	70.12	6.00	3.10	3.40	5.40	196.36	243.42	144.70	144.99	29.43	1.07	0.64	27.33
3/21/2014 11:04	127.16	18.09	69.97	6.00	3.10	3.40	5.40	196.84	243.43	144.76	144.78	29.41	1.12	0.74	27.02
3/21/2014 11:05	127.17	18.09	70.02	6.00	3.10	3.40	5.40	197.35	243.61	144.74	144.73	29.46	1.18	0.49	26.73
3/21/2014 11:06	127.17	18.08	70.23	6.00	3.10	3.40	5.40	196.71	242.81	144.68	144.55	29.50	1.40	0.36	28.93
3/21/2014 11:07	127.16	18.05	70.39	6.00	3.10	3.40	5.40	196.15	242.76	144.71	144.63	29.51	1.43	0.65	27.92
3/21/2014 11:08	127.16	17.97	70.32	6.00	3.10	3.40	5.40	196.23	242.60	144.80	144.89	29.45	1.21	0.30	26.73
3/21/2014 11:09	127.16	17.97	70.18	6.00	3.10	3.40	5.40	196.34	242.90	144.82	144.94	29.41	1.12	0.60	27.97
3/21/2014 11:10	127.16	17.97	69.93	6.00	3.10	3.40	5.40	197.34	244.00	144.88	145.10	29.38	1.21	0.82	27.39
3/21/2014 11:11	127.16	17.99	69.90	6.00	3.10	3.40	5.40	197.78	244.31	144.84	145.10	29.48	1.30	0.40	27.78
3/21/2014 11:12	127.16	18.08	70.11	6.00	3.10	3.40	5.40	197.75	245.13	144.69	145.10	29.63	1.35	0.28	29.33
3/21/2014 11:13	127.16	18.04	70.44	6.00	3.10	3.40	5.40	196.65	243.76	144.73	145.13	29.68	1.34	0.50	29.64
3/21/2014 11:14	127.16	17.91	70.63	6.00	3.10	3.40	5.40	196.29	242.86	144.86	145.24	29.66	1.31	0.70	29.63
3/21/2014 11:15	127.15	17.96	70.52	6.00	3.10	3.40	5.40	196.95	243.61	144.88	145.27	29.58	1.30	0.72	31.14
3/21/2014 11:16	127.15	18.11	70.26	6.00	3.10	3.40	5.40	196.71	243.58	144.95	145.35	29.56	1.28	1.04	29.15
3/21/2014 11:17	127.16	18.09	70.10	6.00	3.10	3.40	5.40	196.60	243.26	144.93	145.31	29.59	1.27	1.22	27.57
3/21/2014 11:18	127.16	18.01	70.25	6.00	3.10	3.40	5.40	196.16	242.47	144.85	145.17	29.56	1.44	0.90	28.45
3/21/2014 11:19	127.16	18.01	70.26	6.00	3.10	3.40	5.40	196.00	242.56	144.84	145.14	29.65	1.32	0.85	29.75
3/21/2014 11:20	127.16	17.98	70.25	6.00	3.10	3.40	5.40	196.36	242.83	144.83	145.04	29.65	1.21	0.96	28.96
3/21/2014 11:21	127.15	17.96	70.10	6.00	3.10	3.40	5.40	196.92	242.65	144.85	144.98	29.66	1.19	0.62	29.87
3/21/2014 11:22	127.15	17.89	70.10	6.00	3.10	3.40	5.40	196.51	242.42	144.90	144.79	29.64	1.15	0.68	29.72
3/21/2014 11:23	127.15	17.93	69.88	6.00	3.10	3.40	5.40	196.17	243.38	144.87	144.80	29.48	1.04	0.71	27.45
3/21/2014 11:24	127.15	18.07	69.82	6.00	3.10	3.40	5.40	195.91	242.82	144.76	144.83	29.51	1.14	0.90	27.22
3/21/2014 11:25	127.16	18.05	69.99	6.00	3.10	3.40	5.40	195.85	242.58	144.76	144.86	29.63	1.29	0.81	28.21
3/21/2014 11:26	127.16	17.96	70.16	6.00	3.10	3.40	5.40	195.78	242.05	144.75	144.94	29.61	1.47	0.62	29.22
3/21/2014 11:27	127.16	17.98	70.17	6.00	3.10	3.40	5.40	196.05	242.75	144.74	144.98	29.54	1.44	0.34	28.70
3/21/2014 11:28	127.16	18.04	70.20	6.00	3.10	3.40	5.40	195.81	242.28	144.71	145.11	29.51	1.34	0.72	27.34
3/21/2014 11:29	127.15	18.04	70.07	6.00	3.10	3.40	5.40	195.90	242.31	144.73	145.12	29.44	1.31	0.81	27.90
3/21/2014 11:30	127.15	18.02	69.82	6.00	3.10	3.40	5.40	195.94	242.41	144.78	145.17	29.46	1.12	0.81	26.49
3/21/2014 11:31	127.15	18.01	69.66	6.00	3.10	3.40	5.40	195.91	242.39	144.78	145.17	29.45	1.07	0.84	28.59
3/21/2014 11:32	127.14	17.99	69.69	6.00	3.10	3.40	5.40	195.29	242.02	144.77	145.19	29.59	1.14	0.82	28.04
3/21/2014 11:33	127.14	17.98	70.05	6.00	3.10	3.40	5.40	195.00	241.41	144.79	145.20	29.72	1.23	0.49	28.41
3/21/2014 11:34	127.14	17.95	70.30	6.00	3.10	3.40	5.40	196.03	242.70	144.85	145.16	29.63	1.17	0.57	27.62
3/21/2014 11:35	127.15	17.97	70.29	6.00	3.10	3.40	5.40	195.57	242.48	144.79	144.95	29.59	1.21	0.52	26.91
3/21/2014 11:36	127.15	18.03	70.24	6.00	3.10	3.40	5.40	195.32	241.76	144.63	144.93	29.55	1.11	0.32	26.64

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS *RATIO* G/MSCF 30C3532L	REGEN COKE *BURNING RATE* MPPH 25CokeBN	Unit 30 Scrubber spay nozzle *Pressure* psig 30SCRspray01psig.or	Unit 30 Scrubber 02 *spay nozzle Pressure* psig 30SCRspray02psig.or	Unit 30 Scrubber 03 *spay nozzle Pressure* psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay *nozzle Pressure* psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/21/2014 11:37	127.15	18.05	70.23	6.00	3.10	3.40	5.40	195.36	241.72	144.69	144.88	29.56	0.94	0.22	25.82
3/21/2014 11:38	127.15	18.10	70.20	6.00	3.10	3.40	5.40	195.06	241.59	144.88	144.87	29.51	0.97	0.22	26.05
3/21/2014 11:39	127.16	18.07	70.17	6.00	3.10	3.40	5.40	195.15	241.69	144.88	144.81	29.48	1.15	0.20	26.27
3/21/2014 11:40	127.16	17.97	70.14	6.00	3.10	3.40	5.40	195.58	242.19	144.87	144.82	29.50	1.12	0.20	24.93
3/21/2014 11:41															
Average	127.16	18.02	70.34	6.00	3.10	3.40	5.40	196.99	243.78	144.63	144.85	29.53	1.16	1.01	27.93

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/21/2014 11:42	127.15	17.97	70.57	6.00	3.10	3.40	5.40	196.20	242.81	144.67	144.82	29.57	1.29	0.20	25.88
3/21/2014 11:43	127.15	18.00	70.61	6.00	3.10	3.40	5.40	196.04	242.72	144.63	144.75	29.56	1.27	0.20	26.82
3/21/2014 11:44	127.15	18.09	70.67	6.00	3.10	3.40	5.40	196.27	242.91	144.58	144.85	29.58	1.25	0.20	26.52
3/21/2014 11:45	127.15	18.06	70.82	6.00	3.10	3.40	5.40	196.65	243.42	144.81	145.13	29.62	1.27	0.20	25.44
3/21/2014 11:46	127.15	17.95	70.64	6.00	3.10	3.40	5.40	196.61	242.95	144.79	145.14	29.53	1.33	0.20	25.94
3/21/2014 11:47	127.15	17.95	70.40	6.00	3.10	3.40	5.40	196.40	242.97	144.74	145.20	29.54	1.35	0.20	27.58
3/21/2014 11:48	127.15	17.94	70.31	6.00	3.10	3.40	5.40	196.23	243.00	144.76	145.23	29.57	1.34	0.20	27.32
3/21/2014 11:49	127.16	17.95	70.43	6.00	3.10	3.40	5.40	196.33	242.98	144.82	145.33	29.58	1.24	0.20	26.13
3/21/2014 11:50	127.16	17.97	70.51	6.00	3.10	3.40	5.40	195.84	242.55	144.82	145.24	29.62	1.25	0.20	25.21
3/21/2014 11:51	127.15	17.98	70.44	6.00	3.10	3.40	5.40	194.67	241.19	144.82	144.98	29.60	1.18	0.20	25.40
3/21/2014 11:52	127.15	18.03	70.39	6.00	3.10	3.40	5.40	194.57	240.53	144.81	144.96	29.51	1.13	0.20	25.85
3/21/2014 11:53	127.15	18.05	70.19	6.00	3.10	3.40	5.40	194.43	240.59	144.79	144.89	29.48	0.96	0.20	24.88
3/21/2014 11:54	127.15	18.12	70.00	6.00	3.10	3.40	5.40	195.27	242.28	144.83	144.89	29.39	0.94	0.20	24.03
3/21/2014 11:55	127.16	18.12	69.81	6.00	3.10	3.40	5.40	195.98	242.38	144.93	144.89	29.37	0.98	0.20	24.01
3/21/2014 11:56	127.16	18.14	69.80	6.00	3.10	3.40	5.40	196.04	242.70	144.85	144.90	29.37	1.18	0.20	24.42
3/21/2014 11:57	127.16	18.12	70.00	6.00	3.10	3.40	5.40	196.26	242.76	144.63	144.93	29.40	1.22	0.20	25.47
3/21/2014 11:58	127.15	18.05	70.17	6.00	3.10	3.40	5.40	196.14	242.94	144.60	144.89	29.44	1.23	0.20	24.24
3/21/2014 11:59	127.15	18.05	70.47	6.00	3.10	3.40	5.40	195.45	242.69	144.51	144.75	29.58	1.26	0.20	25.84
3/21/2014 12:00	127.15	18.07	70.66	6.00	3.10	3.40	5.40	195.51	241.87	144.55	144.82	29.59	1.33	0.20	24.59
3/21/2014 12:01	127.14	18.04	70.66	6.00	3.10	3.40	5.40	195.60	241.75	144.67	145.04	29.64	1.04	0.20	23.07
3/21/2014 12:02	127.14	17.93	70.63	6.00	3.10	3.40	5.40	195.53	241.80	144.66	145.03	29.57	0.94	0.20	23.07
3/21/2014 12:03	127.15	17.94	70.46	6.00	3.10	3.40	5.40	196.30	243.04	144.61	144.88	29.54	0.95	0.20	23.79
3/21/2014 12:04	127.14	17.99	70.37	6.00	3.10	3.40	5.40	195.95	242.39	144.57	144.57	29.58	1.17	0.20	25.58
3/21/2014 12:05	127.09	17.98	70.39	6.00	3.10	3.40	5.40	196.17	242.80	144.47	144.53	29.61	0.98	0.20	23.36
3/21/2014 12:06	127.08	17.95	70.52	6.00	3.10	3.40	5.40	196.14	242.76	144.44	144.39	29.57	1.16	0.20	24.64
3/21/2014 12:07	127.03	17.97	70.71	6.00	3.10	3.40	5.40	195.80	242.27	144.32	144.36	29.62	1.27	0.20	24.78
3/21/2014 12:08	127.02	18.02	70.78	6.00	3.10	3.40	5.40	195.09	241.26	144.31	144.25	29.67	1.03	0.20	25.46
3/21/2014 12:09	126.99	17.99	70.73	6.00	3.10	3.40	5.40	195.65	241.85	144.30	144.32	29.59	1.03	0.20	25.83
3/21/2014 12:10	126.99	17.92	70.49	6.00	3.10	3.40	5.40	195.92	242.14	144.28	144.54	29.49	1.12	0.20	24.54
3/21/2014 12:11	126.99	18.12	70.21	6.00	3.10	3.40	5.40	196.61	243.08	144.20	144.50	29.47	1.27	0.20	24.31
3/21/2014 12:12	126.99	18.08	70.25	6.00	3.10	3.40	5.40	196.93	242.96	144.17	144.35	29.51	1.39	0.20	25.82
3/21/2014 12:13	126.97	17.93	70.45	6.00	3.10	3.40	5.40	196.83	242.73	144.06	144.41	29.56	1.46	0.20	27.39
3/21/2014 12:14	126.96	17.95	70.61	6.00	3.10	3.40	5.40	196.67	243.20	144.08	144.60	29.63	1.28	0.20	26.92
3/21/2014 12:15	126.95	18.00	70.65	6.00	3.10	3.40	5.40	196.00	242.91	144.17	144.56	29.63	1.31	0.20	25.59
3/21/2014 12:16	126.95	17.98	70.58	6.00	3.10	3.40	5.40	195.46	241.94	144.13	144.45	29.68	1.42	0.20	26.67
3/21/2014 12:17	126.94	17.94	70.56	6.00	3.10	3.40	5.40	195.34	241.99	144.10	144.46	29.66	1.30	0.20	27.23
3/21/2014 12:18	126.95	17.94	70.46	6.00	3.10	3.40	5.40	195.77	242.16	144.32	144.48	29.61	1.12	0.20	25.32
3/21/2014 12:19	126.96	17.93	70.34	6.00	3.10	3.40	5.40	195.40	242.07	144.25	144.38	29.68	1.19	0.20	25.98
3/21/2014 12:20	126.97	17.95	70.41	6.00	3.10	3.40	5.40	195.14	241.79	144.02	144.06	29.68	1.26	0.20	25.96
3/21/2014 12:21	127.00	18.02	70.31	6.00	3.10	3.40	5.40	195.72	241.86	144.03	144.07	29.59	1.07	0.20	25.73
3/21/2014 12:22	127.00	18.03	70.18	6.00	3.10	3.40	5.40	195.76	242.34	144.06	144.13	29.53	1.20	0.20	25.28
3/21/2014 12:23	127.01	18.08	70.21	6.00	3.10	3.40	5.40	196.20	242.89	144.03	144.10	29.58	1.24	0.20	25.13
3/21/2014 12:24	127.01	18.02	70.33	6.00	3.10	3.40	5.40	195.57	242.20	143.95	144.00	29.61	1.29	0.20	25.20
3/21/2014 12:25	127.01	17.87	70.47	6.00	3.10	3.40	5.40	195.17	242.12	143.96	144.04	29.59	1.44	0.20	26.69
3/21/2014 12:26	127.02	17.90	70.47	6.00	3.10	3.40	5.40	194.95	241.45	143.98	144.18	29.61	1.38	0.20	26.70
3/21/2014 12:27	127.03	17.99	70.47	6.00	3.10	3.40	5.40	194.21	240.08	143.97	144.22	29.61	1.33	0.20	26.42
3/21/2014 12:28	127.03	17.98	70.46	6.00	3.10	3.40	5.40	194.09	240.04	143.94	144.41	29.67	1.24	0.20	25.69
3/21/2014 12:29	127.03	17.95	70.39	6.00	3.10	3.40	5.40	194.09	240.11	143.99	144.63	29.66	1.19	0.20	26.16
3/21/2014 12:30	127.03	17.96	70.23	6.00	3.10	3.40	5.40	194.31	240.78	144.14	144.62	29.60	1.11	0.20	24.64
3/21/2014 12:31	127.01	18.02	70.16	6.00	3.10	3.40	5.40	193.73	240.41	144.13	144.50	29.56	1.07	0.20	24.96
3/21/2014 12:32	127.01	17.99	70.24	6.00	3.10	3.40	5.40	193.67	239.49	144.11	144.28	29.56	1.35	0.20	26.12
3/21/2014 12:33	127.02	17.90	70.26	6.00	3.10	3.40	5.40	194.61	239.98	144.12	144.23	29.59	1.33	0.20	26.72
3/21/2014 12:34	127.02	17.92	70.34	6.00	3.10	3.40	5.40	194.38	239.50	144.15	144.08	29.61	1.31	0.38	26.69
3/21/2014 12:35	127.01	17.98	70.47	6.00	3.10	3.40	5.40	193.34	239.27	144.13	144.03	29.57	1.26	0.92	26.98
3/21/2014 12:36	127.02	18.00	70.51	6.00	3.10	3.40	5.40	192.51	238.58	144.05	143.88	29.56	1.19	0.82	27.59
3/21/2014 12:37	127.03	18.07	70.37	6.00	3.10	3.40	5.40	193.13	238.76	144.04	143.92	29.47	1.01	1.03	26.37
3/21/2014 12:38	127.03	18.03	70.22	6.00	3.10	3.40	5.40	192.87	239.29	143.99	144.07	29.53	1.14	1.23	27.52
3/21/2014 12:39	127.03	17.91	70.30	6.00	3.10	3.40	5.40	192.93	239.12	144.02	144.17	29.52	0.99	1.92	27.37
3/21/2014 12:40	127.02	17.95	70.31	6.00	3.10	3.40	5.40	193.37	238.93	144.12	144.49	29.51	0.88	2.10	26.91
3/21/2014 12:41	127.02	18.06	70.35	6.00	3.10	3.40	5.40	194.13	239.71	144.10	144.48	29.52	0.94	2.21	27.30
3/21/2014 12:42	127.02	18.06	70.35	6.00	3.10	3.40	5.40	193.93	239.23	144.01	144.44	29.48	0.98	2.56	28.03
3/21/2014 12:43	127.01	18.05	70.36	6.00	3.10	3.40	5.40	193.67	239.21	143.96	144.38	29.48	0.91	2.57	27.03
3/21/2014 12:44	127.01	18.07	70.53	6.00	3.10	3.40	5.40	193.24	239.15	143.82	144.17	29.54	0.95	2.62	28.16
3/21/2014 12:45	127.02	18.13	70.79	6.00	3.10	3.40	5.40	192.89	238.95	143.86	144.13	29.56	0.92	2.72	28.11
3/21/2014 12:46	127.02	18.10	70.93	6.00	3.10	3.40	5.40	192.59	238.41	143.98	144.00	29.60	0.91	2.89	28.09
3/21/2014 12:47	127.02	18.03	70.92	6.00	3.10	3.40	5.40	192.80	238.39	143.99	143.99	29.53	0.91	2.91	28.34
3/21/2014 12:48	127.02	18.04	70.89	6.00	3.10	3.40	5.40	193.17	238.62	144.02	143.95	29.52	0.90	2.61	27.50

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	*Unit 30 Scrubber 02* spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER *FEED CORR.* MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI6008	FLUE GAS SCRUBBR STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI5014	SCRUBBER STACK SO2 *ppm* 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/21/2014 12:49															
Average	127.06	18.00	70.43	6.00	3.10	3.40	5.40	195.08	241.37	144.31	144.51	29.56	1.17	0.59	25.94

Time	CORRECTED REACTOR FEED MBPD 25F3012A	LIQUID TO GAS RATIO G/MSCF 30C3532L	REGEN COKE BURNING RATE MPPH 25CokeBN	Unit 30 Scrubber spay nozzle Pressure psig 30SCRspray01psig.or	Unit 30 Scrubber 02 spay nozzle Pressure psig 30SCRspray02psig.or	Unit 30 Scrubber 03 spay nozzle Pressure psig 30SCRspray03psig.or	Unit 30 Scrubber 04 spay nozzle Pressure psig 30SCRspray04psig.or	OXYGEN & BLOWER FEED CORR. MSCF 25Airtot	THROAT VELOCITY feet/min 25C3147V	FLUE GAS STK TMP deg F 30TI5008	FLUE GAS SCRUBBER STK TMP deg F 30TI1807	Dry Flue Gas Rate MMOL/H 25F3147D	SCRUBBER STACK O2 % 30AI6014	SCRUBBER STACK SO2 ppm 30AI6013	SCRUBBER SELECTED NOX ppm 30AI6012
3/21/2014 14:08	127.02	18.02	70.89	6.00	3.10	3.40	5.40	195.48	241.60	144.46	144.35	29.40	1.06	0.20	23.13
3/21/2014 14:09	127.03	18.05	70.61	6.00	3.10	3.40	5.40	195.32	241.62	144.25	144.11	29.44	1.10	0.20	23.18
3/21/2014 14:10	127.02	18.14	70.83	6.00	3.10	3.40	5.40	195.48	241.67	144.22	144.18	29.48	1.14	0.20	23.32
3/21/2014 14:11	127.02	18.13	71.14	6.00	3.10	3.40	5.40	194.42	241.36	144.13	144.43	29.53	1.12	0.20	22.94
3/21/2014 14:12	127.03	18.07	71.24	6.00	3.10	3.40	5.40	194.46	240.55	144.16	144.48	29.53	1.09	0.20	21.78
3/21/2014 14:13	127.03	18.01	71.25	6.00	3.10	3.40	5.40	194.49	240.96	144.26	144.63	29.56	1.01	0.20	22.42
3/21/2014 14:14	127.03	17.81	71.31	6.00	3.10	3.40	5.40	194.16	240.60	144.28	144.69	29.68	1.00	0.20	23.55
3/21/2014 14:15	127.02	17.84	71.34	6.00	3.10	3.40	5.40	194.13	239.76	144.36	144.86	29.65	0.84	0.20	21.24
3/21/2014 14:16	127.02	17.92	71.21	6.00	3.10	3.40	5.40	194.71	240.79	144.35	144.80	29.57	0.79	0.20	20.79
3/21/2014 14:17	127.02	17.95	70.90	6.00	3.10	3.40	5.40	195.44	241.73	144.34	144.60	29.45	0.84	0.20	19.78
3/21/2014 14:18	127.02	18.02	70.77	6.00	3.10	3.40	5.40	195.40	241.57	144.32	144.54	29.45	0.94	0.20	20.65
3/21/2014 14:19	127.01	18.01	70.88	6.00	3.10	3.40	5.40	194.44	240.83	144.26	144.35	29.47	0.89	0.20	19.62
3/21/2014 14:20	127.01	18.00	71.08	6.00	3.10	3.40	5.40	194.35	240.02	144.26	144.31	29.52	0.80	0.20	18.88
3/21/2014 14:21	127.01	18.02	71.30	6.00	3.10	3.40	5.40	194.07	240.07	144.27	144.18	29.58	0.92	0.20	21.72
3/21/2014 14:22	127.02	18.08	71.50	6.00	3.10	3.40	5.40	194.21	240.38	144.30	144.26	29.60	0.90	0.20	21.26
3/21/2014 14:23	127.03	18.07	71.45	6.00	3.10	3.40	5.40	194.60	240.89	144.38	144.52	29.53	0.91	0.20	21.80
3/21/2014 14:24	127.03	18.05	71.46	6.00	3.10	3.40	5.40	194.65	241.01	144.33	144.50	29.49	1.04	0.20	21.16
3/21/2014 14:25	127.02	18.02	71.49	6.00	3.10	3.40	5.40	194.69	241.39	144.16	144.41	29.57	1.09	0.20	23.11
3/21/2014 14:26	127.02	17.94	71.51	6.00	3.10	3.40	5.40	194.35	241.10	144.17	144.44	29.57	1.21	0.20	23.93
3/21/2014 14:27	127.01	17.95	71.61	6.00	3.10	3.40	5.40	194.10	240.20	144.17	144.57	29.64	1.23	0.20	24.00
3/21/2014 14:28	127.02	17.97	71.67	6.00	3.10	3.40	5.40	194.03	240.49	144.21	144.61	29.63	1.19	0.20	23.27
3/21/2014 14:29	127.03	18.00	71.41	6.00	3.10	3.40	5.40	194.77	241.00	144.33	144.75	29.57	0.92	0.20	20.74
3/21/2014 14:30	127.03	18.08	71.15	6.00	3.10	3.40	5.40	193.90	240.15	144.32	144.66	29.56	1.04	0.20	21.34
3/21/2014 14:31	127.04	18.07	70.97	6.00	3.10	3.40	5.40	194.30	240.74	144.30	144.39	29.58	1.15	0.20	21.50
3/21/2014 14:32	127.03	18.06	70.90	6.00	3.10	3.40	5.40	194.19	240.68	144.29	144.37	29.53	1.10	0.20	22.01
3/21/2014 14:33	127.02	18.06	70.87	6.00	3.10	3.40	5.40	194.22	240.50	144.25	144.32	29.51	1.11	0.20	22.07
3/21/2014 14:34	127.02	18.04	70.78	6.00	3.10	3.40	5.40	194.32	240.63	144.24	144.29	29.47	1.06	0.34	22.84
3/21/2014 14:35	127.03	18.03	70.76	6.00	3.10	3.40	5.40	194.16	240.65	144.24	144.20	29.54	0.90	1.04	24.42
3/21/2014 14:36	127.03	17.99	70.91	6.00	3.10	3.40	5.40	193.52	239.31	144.28	144.28	29.58	0.82	1.70	23.34
3/21/2014 14:37	127.03	18.01	71.00	6.00	3.10	3.40	5.40	193.19	238.90	144.42	144.55	29.60	0.75	1.70	22.70
3/21/2014 14:38	127.03	18.08	70.99	6.00	3.10	3.40	5.40	193.67	240.09	144.41	144.59	29.52	0.84	2.30	23.23
3/21/2014 14:39	127.02	18.06	70.91	6.00	3.10	3.40	5.40	194.17	240.98	144.39	144.73	29.44	0.78	2.30	22.32
3/21/2014 14:40	127.02	17.99	70.84	6.00	3.10	3.40	5.40	194.55	240.90	144.37	144.75	29.47	1.07	2.18	24.80
3/21/2014 14:41	127.03	18.00	71.04	6.00	3.10	3.40	5.40	194.49	240.46	144.29	144.80	29.51	0.95	1.84	25.16
3/21/2014 14:42	127.03	18.04	71.48	6.00	3.10	3.40	5.40	193.91	239.86	144.31	144.78	29.58	0.98	2.27	26.24
3/21/2014 14:43	127.03	18.05	71.77	6.00	3.10	3.40	5.40	193.85	240.25	144.38	144.72	29.63	0.89	2.50	25.47
3/21/2014 14:44	127.03	18.08	71.54	6.00	3.10	3.40	5.40	195.11	241.42	144.37	144.63	29.52	0.73	2.92	23.16
3/21/2014 14:45	127.03	18.07	71.28	6.00	3.10	3.40	5.40	195.02	241.26	144.25	144.30	29.45	0.91	2.65	23.52
3/21/2014 14:46	127.03	18.04	71.15	6.00	3.10	3.40	5.40	194.84	240.81	144.04	144.11	29.45	1.16	2.75	25.47
3/21/2014 14:47	127.02	18.02	71.31	6.00	3.10	3.40	5.40	195.20	241.03	144.10	144.13	29.52	1.16	3.20	27.54
3/21/2014 14:48	127.03	17.97	71.48	6.00	3.10	3.40	5.40	195.08	241.21	144.30	144.21	29.57	1.03	3.07	26.29
3/21/2014 14:49	127.03	17.98	71.63	6.00	3.10	3.40	5.40	194.18	240.03	144.29	144.22	29.59	1.02	3.01	26.50
3/21/2014 14:50	127.03	18.02	71.41	6.00	3.10	3.40	5.40	194.40	240.31	144.22	144.33	29.55	0.87	2.83	24.12
3/21/2014 14:51	127.03	18.01	71.21	6.00	3.10	3.40	5.40	194.17	239.55	144.21	144.52	29.49	0.93	2.88	24.87
3/21/2014 14:52	127.03	17.97	71.07	6.00	3.10	3.40	5.40	193.46	240.14	144.16	144.54	29.52	0.94	3.00	26.88
3/21/2014 14:53	127.03	17.97	71.21	6.00	3.10	3.40	5.40	193.78	240.31	144.18	144.61	29.56	1.02	2.70	25.83
3/21/2014 14:54	127.03	17.99	71.28	6.00	3.10	3.40	5.40	194.74	240.85	144.25	144.60	29.52	1.10	2.32	24.41
3/21/2014 14:55	127.03	17.98	71.29	6.00	3.10	3.40	5.40	194.78	240.91	144.20	144.57	29.55	0.93	2.28	23.73
3/21/2014 14:56	127.03	17.94	71.34	6.00	3.10	3.40	5.40	194.77	241.10	144.07	144.48	29.56	0.90	2.16	24.61
3/21/2014 14:57	127.03	17.96	71.36	6.00	3.10	3.40	5.40	194.49	241.14	144.04	144.21	29.57	1.05	2.03	25.36
3/21/2014 14:58	127.03	18.01	71.33	6.00	3.10	3.40	5.40	194.73	241.04	143.96	144.15	29.59	1.09	1.69	24.89
3/21/2014 14:59	127.03	17.99	71.46	6.00	3.10	3.40	5.40	194.14	240.08	143.96	143.95	29.64	1.02	1.73	25.46
3/21/2014 15:00	127.03	17.93	71.60	6.00	3.10	3.40	5.40	194.05	239.71	143.95	143.94	29.63	0.92	1.24	24.15
3/21/2014 15:01	127.04	17.94	71.39	6.00	3.10	3.40	5.40	194.78	240.97	143.91	143.89	29.59	0.79	1.18	22.72
3/21/2014 15:02	127.04	17.96	71.24	6.00	3.10	3.40	5.40	193.91	240.37	143.78	143.88	29.59	1.06	1.09	24.69
3/21/2014 15:03	127.03	17.97	71.23	6.00	3.10	3.40	5.40	193.95	239.99	143.76	143.87	29.56	1.07	0.78	23.94
3/21/2014 15:04	127.03	18.01	71.20	6.00	3.10	3.40	5.40	193.94	239.69	143.70	143.90	29.54	1.35	0.73	23.75
3/21/2014 15:05	127.01	18.01	71.13	6.00	3.10	3.40	5.40	193.45	238.92	143.73	144.03	29.46	1.14	0.70	25.41
3/21/2014 15:06	127.02	18.00	71.09	6.00	3.10	3.40	5.40	193.23	239.34	143.84	144.11	29.46	1.01	0.59	24.61
3/21/2014 15:07	127.03	18.01	70.96	6.00	3.10	3.40	5.40	193.90	239.59	143.87	144.34	29.54	0.92	0.55	21.99
3/21/2014 15:08	127.03	18.03	70.97	6.00	3.10	3.40	5.40	194.33	240.35	143.96	144.34	29.58	0.86	0.71	21.27
3/21/2014 15:09	127.02	18.00	70.98	6.00	3.10	3.40	5.40	194.49	240.30	143.94	144.23	29.58	0.97	0.72	21.82
3/21/2014 15:10	127.02	17.90	71.02	6.00	3.10	3.40	5.40	194.28	240.34	143.87	143.97	29.62	1.02	0.79	23.20
3/21/2014 15:11	127.02	17.93	71.19	6.00	3.10	3.40	5.40	194.44	240.92	143.87	143.97	29.66	0.84	0.89	22.36
3/21/2014 15:12															
Average	127.03	18.01	71.20	6.00	3.10	3.40	5.40	194.37	240.55	144.18	144.38	29.55	0.99	1.16	23.32

PROTOCOL

J

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: [illegible]

Date: 05/14

CleanAir.

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Marathon Petroleum Company LP
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PROTOCOL ON COMPLIANCE TESTING

Prepared for:
MARATHON PETROLEUM COMPANY LP
FCC REGENERATOR VENT (EQT 0165)
GARYVILLE REFINERY

Client Reference No:
CleanAir Project No: Protocol
Revision D0a: February 14, 2014

To the best of our knowledge, the test plan and any state and federal regulations presented in this protocol have met all pre-determined program requirements. Modifications to the test plan or methodology presented in this original protocol will be performed only at the discretion of CleanAir and in accordance with all applicable parties involved. CleanAir operates in conformance with the requirements of ASTM D7036-04 Standard Practice for *Competence of Air Emission Testing Bodies.*

Submitted by,

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REVISION HISTORY

PROTOCOL ON COMPLIANCE TESTING

DRAFT PROTOCOL REVISION HISTORY

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PROJECT OVERVIEW

INTRODUCTION

Marathon Petroleum Company LP (MPC) contracted Clean Air Engineering (CleanAir) to perform emission measurements at the Garyville Refinery for compliance purposes.

All testing will be conducted in accordance with the regulations set-forth by the United States Environmental Protection Agency (EPA) and the Louisiana Department of Environmental Quality (DEQ). The permit limits are referenced in the following source:

- State of Louisiana Department of Environmental Quality, Environmental Services, Permit No. 2580-00013-V11.

Project Objectives

The goal of the test program is to determine if the facility is in compliance with the particulate, sulfur trioxide, volatile organic compound and hydrogen cyanide emission limits for the FCC Regenerator Vent (EQT 0165).

Testing is tentatively scheduled to take place during the week of March 17, 2014.

Key Project Participants

Individuals responsible for coordinating and conducting the test program are listed below in Table 1-1.

Table 1-1:
Project Contact Information

Client Contact	CleanAir Contact
Elizabeth Olavesen	Andy Obuchowski
Marathon Petroleum Company LP	Clean Air Engineering
Garyville Refinery	Midwest Engineering Group
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PROJECT OVERVIEW

Test Program Parameters

The testing will be performed at the FCC Regenerator Vent and will include the following emissions measurements:

- particulate matter (PM), assumed equivalent to filterable particulate matter (FPM) only
- total particulate matter less than 10 microns (μm) in diameter (Total PM_{10}), assumed equivalent to the sum of the following constituent:
    - filterable particulate matter (FPM)
    - condensable particulate matter (CPM)
- sulfuric acid mist (H_2SO_4)
- hydrogen cyanide (HCN)
- volatile organic compounds (VOCs), assumed equivalent to total hydrocarbons (THC) minus the following constituents:
    - methane (CH_4)
    - ethane (C_2H_6)
- flue gas flow rate
- flue gas velocity decay (wall effects)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas temperature

PROJECT OVERVIEW

SCOPE OF WORK

Test Schedule

The on-site schedule to be followed during the test program is outlined in Table 1-2.

Table 1-2:
Schedule of Activities

Day	Activity	Location	Run Number	Method (USEPA)	Analyte(s)	Sampling Time (min)
1	Mobilization					
2	Safety Training (if necessary)					
	Equipment Setup	FCC Regenerator Vent				
3	Toolbox Safefy Meeting					
	Equipment Setup	FCC Regnerator Vent				
	Preliminary Testing	(Condition 1)	1	M-2H	Velocity Decay	varies
	Emissions Testing		1	M-5/202	FPM/CPM	60
			1	OTM-29	HCN	60
			1	M-2F	3-D Flow	varies
	Recovery					
	Emissions Testing		2	M-5/202	FPM/CPM	60
			2	OTM-29	HCN	60
			2	M-2F	3-D Flow	varies
	Recovery					
	Emissions Testing		3	M-5/202	FPM/CPM	60
			3	OTM-29	HCN	60
			3	M-2F	3-D Flow	varies
	Recovery					
4	Toolbox Safefy Meeting					
	Preliminary Testing	FCC Regnerator Vent	2	M-2H	Velocity Decay	varies
	Emissions Testing	(Condition 2)	4	M-5/202	FPM/CPM	60
			4	OTM-29	HCN	60
			4	M-2F	3-D Flow	varies
	Recovery					
	Emissions Testing		5	M-5/202	FPM/CPM	60
			5	OTM-29	HCN	60
			5	M-2F	3-D Flow	varies
	Recovery					
	Emissions Testing		6	M-5/202	FPM/CPM	60
			6	OTM-29	HCN	60
			6	M-2F	3-D Flow	varies
	Recovery					

Table 1-2 (Continued):
Schedule of Activities

5	Toolbox Safefy Meeting					
	Preliminary Testing	FCC Regnerator Vent	3	M-2H	Velocity Decay	varies
			0	Draft ASTM CCM	H_2SO_4	60
	Emissions Testing	(Condition 2)	1	M-3A / 25A	O_2 / CO_2 / THC	60
			1	M-18	CH_4 / C_2H_6	60
			1	Draft ASTM CCM	H_2SO_4	60
			7	M-2F	3-D Flow	varies
	Recovery / Calibration					
	Emissions Testing		2	M-3A / 25A	O_2 / CO_2 / THC	60
			2	M-18	CH_4 / C_2H_6	60
			2	Draft ASTM CCM	H_2SO_4	60
			8	M-2F	3-D Flow	varies
	Recovery / Calibration					
	Emissions Testing		3	M-3A / 25A	O_2 / CO_2 / THC	60
			3	M-18	CH_4 / C_2H_6	60
			3	Draft ASTM CCM	H_2SO_4	60
			9	M-2F	3-D Flow	varies
	Recovery / Calibration					
6	Toolbox Safefy Meeting					
	Preliminary Testing	FCC Regnerator Vent	4	M-2H	Velocity Decay	varies
	Emissions Testing	(Condition 1)	4	M-3A / 25A	O_2 / CO_2 / THC	60
			4	M-18	CH_4 / C_2H_6	60
			4	Draft ASTM CCM	H_2SO_4	60
			10	M-2F	3-D Flow	varies
	Recovery / Calibration					
	Emissions Testing		5	M-3A / 25A	O_2 / CO_2 / THC	60
			5	M-18	CH_4 / C_2H_6	60
			5	Draft ASTM CCM	H_2SO_4	60
			11	M-2F	3-D Flow	varies
	Recovery / Calibration					
	Emissions Testing		6	M-3A / 25A	O_2 / CO_2 / THC	60
			6	M-18	CH_4 / C_2H_6	60
			6	Draft ASTM CCM	H_2SO_4	60
			12	M-2F	3-D Flow	varies
	Recovery / Calibration					
7	Equipment Breakdown Demobilization	FCC Regenerator Vent				

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PROJECT OVERVIEW

SCOPE OF WORK (CONTINUED)

Permit Limits

Table 1-3 summarizes the permit limits of the sources to be included in the test program.

Table 1-3:
Summary of Permit Limits

Source Constituent	Sampling Method	Permit Limit[1]
FCC Regenerator Vent		
PM_{10}[2] (lb/hr)	USEPA M-5/202	24.00
PM_{10}[2] (ton/yr)	USEPA M-5/202	105.12
PM_{10}[2] (lb/Mlb coke)	USEPA M-5/202	0.30
$PM_{2.5}$[3] (lb/hr)	USEPA M-5/202	13.71
$PM_{2.5}$[3] (ton/yr)	USEPA M-5/202	60.07
H_2SO_4 (lb/hr)	ASTM Draft CCM	8.50
H_2SO_4 (ton/yr)	ASTM Draft CCM	37.22
VOC (lb/hr)	USEPA M-25A/18	6.81
VOC (ton/yr)	USEPA M-25A/18	29.84
HCN (lb/hr)	USEPA OTM-29	7.96
HCN (ton/yr)	USEPA OTM-29	34.85

[1] Limits obtained from permit No. 2580-00013.V11 021414 142548

[2] PM_{10} = Particulate matter less than 10 microns

[3] $PM_{2.5}$ = Particulate matter less than 2.5 microns

PROJECT OVERVIEW 1-6

SCOPE OF WORK (CONTINUED)

Discussion of Test Program

Mobilization and Equipment Set-up

The test crew will mobilize to the Garyville area on Sunday. If necessary, Monday morning the test crew will attend safety orientation. Following safety orientation, the crew will mobilize to the plant. A work permit will be obtained from the Complex control room prior to initiating equipment set-up.

The trailer will be staged near the base of the FCC Regenerator Stack and made ready to be hooked up to a 480-V, single-phase power supply. Detailed wiring instructions for wiring CleanAir trailers are included in Appendix C.

The process of equipment set-up will begin on Monday and is anticipated to be completed Tuesday morning. Assistance from facility personnel with initial opening of the sample ports and cleaning out of accumulated debris is requested.

General Considerations

O_2 and CO_2 data (units of dry volume percent, $\%_{dv}$) used in molecular weight calculations will be obtained in the following manner during the test program:

- For non-instrumental (wet) sampling methods, a modified version of EPA Method 3B will be utilized.
  - Multi-point, integrated gas samples (IGS) will be continuously collected at a constant rate from a slipstream of the exhaust of the sample trains into a flexible vinyl bag (IGS bag) per Method 3B specifications.
  - A calibrated paramagnetic/IR analyzer will be used in place of a traditional Orsat analyzer to measure drift-corrected O_2 and CO_2 concentrations of the IGS bags per Method 3A specifications.
  - Documentation of preliminary instrument calibrations and post-analysis calibration checks will be included in the appendices of the final report.
- For instrumental (continuous) test methods, O_2 and CO_2 data will be obtained from a continuous paramagnetic / non-dispersive infrared (NDIR) analyzer operated concurrently and in parallel with the other analyzers per Method 3A specifications.

PROJECT OVERVIEW

H_2O data (units of volume percent, $\%_v$) used for moisture correction of concentration data will be obtained (when required) in the following manner during the test program:

- For Method 5/202, Draft ASTM CCM, and OTM-29 Method 4 measurements are incorporated into the sampling and recovery procedures.
- Method 18 and Method 25A H_2O data will be obtained from concurrently operated Draft ASTM CCM sample trains.

At the FCC Regenerator Stack, flow rate measurements will be obtained per Method 2F. A 3-D flow traverse will be performed before and after each set of emission test runs. To account for flue gas velocity decay near the stack walls, a wall-effect adjustment factor will be determined per Method 2H prior to the first run each day.

MPC will be responsible for collecting relevant process data over the time period of each sample run.

End of Section 1 – Project Overview

DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

MPC's facility, located in Garyville, Louisiana, produces refined petroleum products from crude oil.

The Fluidized Catalytic Cracking Unit (FCCU) converts gas oil into gasoline and other hydrocarbons. Hydrotreated heavy gas oil is contacted with silica alumina catalyst at the base of the reactor riser. The oil is cracked and the reactor stream tops are diverted to a fractionator. During the cracking process, coke is deposited on the catalyst requiring it to be continuously regenerated and contacted with air at approximately 1,350 degrees F to burn the coke off the catalyst. The regenerator flue gas is sent to a wet scrubber, while the catalyst is recycled.

The testing described in this document will be performed at FCC Regenerator Vent Stack.

DESCRIPTION OF SAMPLING LOCATIONS

Sampling point locations will be determined according to EPA Method 1 and 2H, where applicable.

Table 2-1 outlines the sampling point configurations. The figures shown on pages 2-2 through 2-4 illustrate the sampling points and orientation of sampling ports for each of the sources to be tested in the program.

Table 2-1:
Sampling Points

Source Constituent	Method (USEPA)	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
FCC Regenerator Stack							
FPM / CPM	M-5/202	1-6	4	6	2.5	60	2-1
HCN	OTM-29	1-6	4	6	2.5	60	2-1
H_2SO_4	Draft ASTM CCM	0-6	1	1	60	60	N/A[1]
O_2 / CO_2 / VOC / THC	M-3A / 18 / 25A	1-6	1	1	60	60	N/A[1]
Flow Rate	M-2F	TBD	4	4	varies	varies	2-2
Velocity Decay	M-2H	TBD	1	10	varies	varies	2-3

[1] Sampling will occur at a single point near the center of the duct

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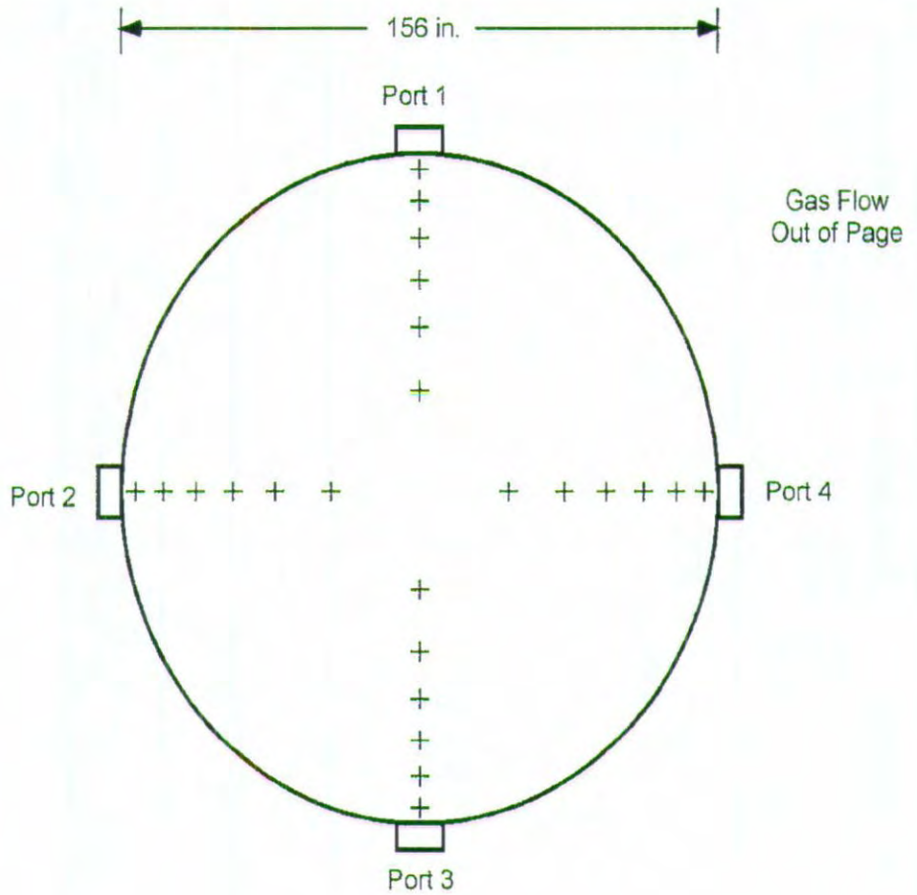
DESCRIPTION OF INSTALLATION

DESCRIPTION OF SAMPLING LOCATIONS (CONTINUED)



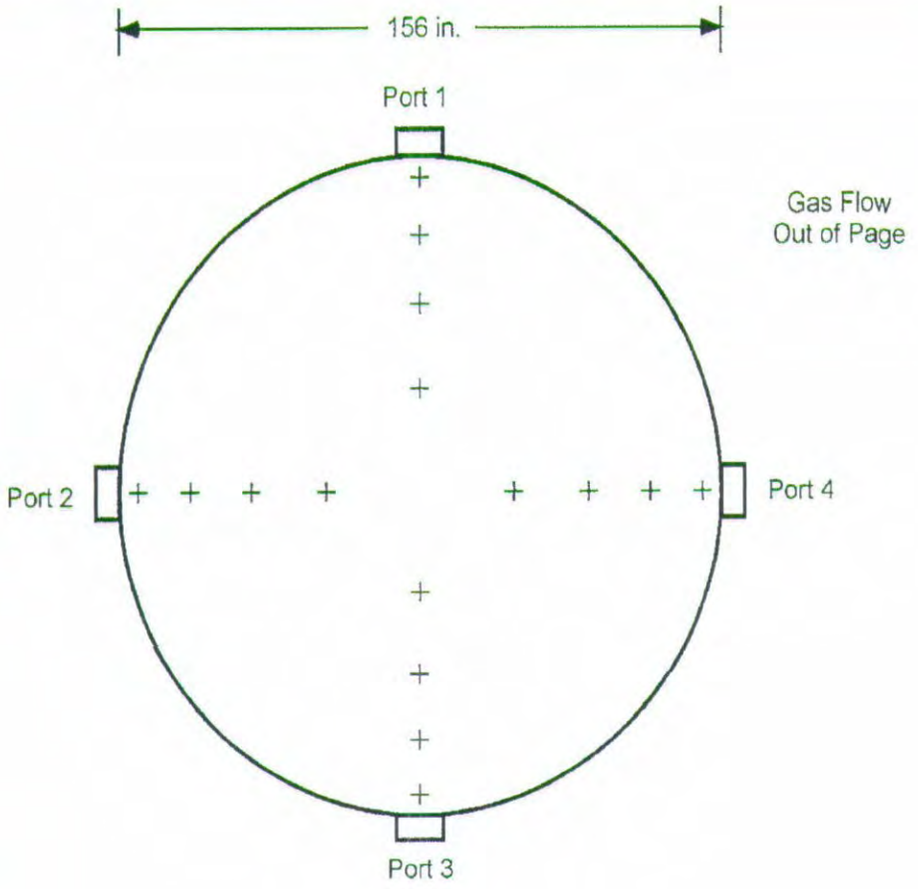
Sampling Point	Port to Point Distance (in.)
1	55.5
2	39.0
3	27.6
4	18.4
5	10.5
6	3.3

Duct diameters upstream from flow disturbance (A):	4.2	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	4.0	Limit: 2.0

Figure 2-1: FCC Regenerator Stack Sampling Points (EPA Method 5/202 & OTM-29)

DESCRIPTION OF INSTALLATION

DESCRIPTION OF SAMPLING LOCATIONS (CONTINUED)



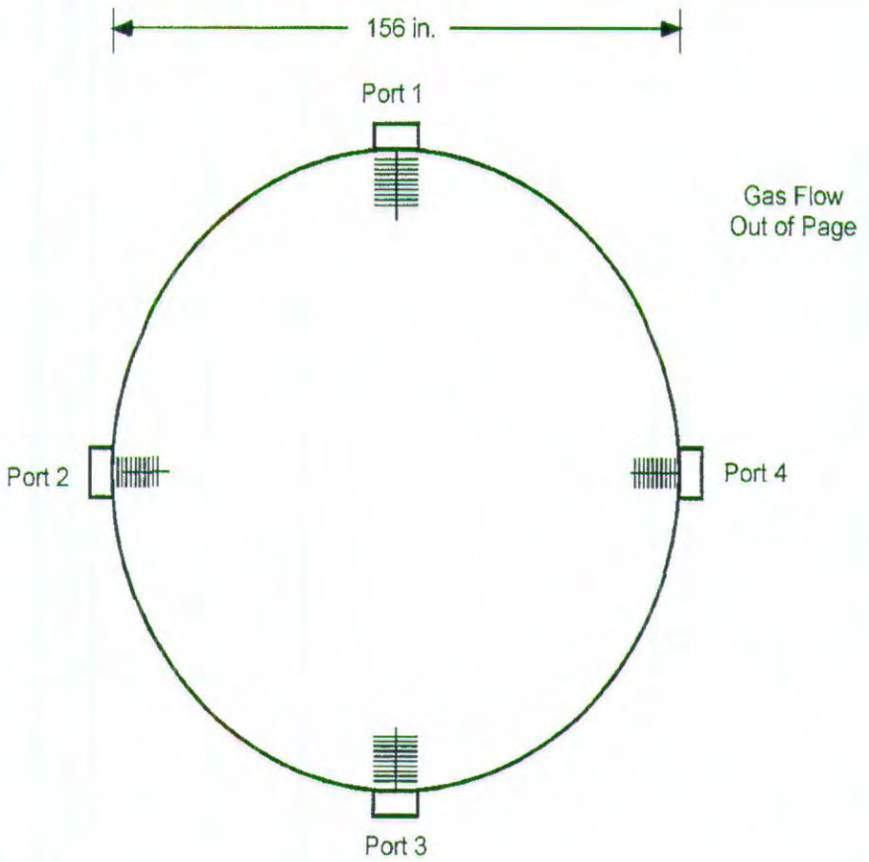
Traverse Point	Port to Point Distance (in.)
1	50.4
2	30.3
3	16.4
4	5.0

Duct diameters upstream from flow disturbance (A):	4.2	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	4.0	Limit: 2.0

Figure 2-2: FCC Regnerator Stack Traverse Points (EPA Method 2F)

DESCRIPTION OF INSTALLATION

DESCRIPTION OF SAMPLING LOCATIONS (CONTINUED)



Traverse Point	Port to Point Distance (in.)
1	10.0
2	9.0
3	8.0
4	7.0
5	6.0
6	5.0
7	4.0
8	3.0
9	2.0
10	1.0

Duct diameters upstream from flow disturbance (A):	4.2	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	4.0	Limit: 2.0

Figure 2-3: FCC Regenerator Traverse Points (EPA Method 2H)

End of Section 2 – Description of Installation

METHODOLOGY

Clean Air Engineering will follow procedures as detailed in EPA Methods 1, 2, 2F, 2H, 3, 3A, 4, 5, 18, 25A, 202, Other Test Method (OTM) 29, and the Draft ASTM Controlled Condensation Method (CCM). The following table summarizes the methods and their respective sources.

Table 3-1:
Summary of Sampling Procedures

Title 40 CFR Part 60 Appendix A	
Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
Method 2F	"Determination of Stack Gas Velocity And Volumetric Flow Rate with Three-Dimensional Probes"
Method 2H	"Determination of Stack Gas Velocity Taking into Account Velocity Decay near the Stack Wall"
Method 3	"Gas Analysis for the Determination of Dry Molecular Weight"
Method 3A	"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)"
Method 4	"Determination of Moisture Content in Stack Gases"
Method 5	"Determination of Particulate Matter Emissions from Stationary Sources"
Method 18	"Measurement of Gaseous Organic Compound Emissions by Gas Chromatography"
Method 25A	"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"
Title 40 CFR Part 51 Appendix M	
Method 202	"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"
Other Test Methods	
OTM-29	"Sampling and Analysis for Hydrogen Cyanide Emissions from Stationary Sources"
Draft Methods	
Draft ASTM CCM	"Standard Test Method for Determination of Sulfur Trioxide and Sulfuric Acid Vapor and Mist, from Stationary Sources using a Controlled Condensation Sampling System

These methods appear in detail in Title 40 of the Code of Federal Regulations (CFR) and on the World Wide Web at http://ecfr.gpoaccess.gov.

Diagrams of the sampling apparatus and major specifications of the sampling, recovery and analytical procedures are summarized for each method in Appendix A.

CleanAir will follow specific quality assurance and quality control (QA/QC) procedures as outlined in the individual methods and as prescribed in CleanAir's internal Quality Manual.

METHODOLOGY

PM and PM_{10} Testing - USEPA Method 5/202

PM and PM_{10} emissions will be determined using USEPA Method 5/202.

- For this test program, PM assumed is equivalent to filterable particulate matter (FPM).
- PM_{10} is equivalent to the sum of filterable particulate matter less than 10 micrometers (μm) in diameter (FPM_{10}) and condensable particulate matter (CPM). The M-5/202 sample train yields a front-half, FPM result and a back-half, CPM result. The total PM result (FPM plus CPM) from M-5/202 can be used as a worst-case estimation of as Total PM_{10} since M-5 will collect all filterable particulate matter present in the flue gas (regardless of particle size).

The front-half (Method 5 portion) of the sampling train consists of a glass nozzle, glass probe liner heated to 250°F and a quartz filter heated to 250°F. Samples will be collected isokinetically; nozzle and probe liner recoveries will be performed using acetone as the recovery solvent.

The back-half (M-202 portion) of the sampling train is designed to mimic ambient conditions and collect only the particles that would truly form CPM in the atmosphere by minimizing the sulfur dioxide (SO_2) and nitrogen oxide (NO_X) interferences observed with earlier versions of the method, in which flue gas was bubbled through cold water and SO_2 and NO_X were absorbed and partially oxidized before they could be purged out with nitrogen (N_2).

Flue gas exiting the front-half heated filter passes through a coiled condenser and dry impinger system jacketed by water continually circulated at ambient temperature. Moisture is removed from the flue gas without bubbling through the condensed water. Flue gas then passes through a tetrafluoroethane (TFE) membrane filter at ambient temperature. The temperature of the flue gas at the exit of the filter is directly measured with an in-line thermocouple and maintained in the temperature range of 65 to 85°F.

After exiting the ambient filter, the flue gas passes through two (2) additional impingers surrounded by ice in a "cold" section of the impinger bucket. The moisture collected in these impingers is not analyzed for CPM and is only collected to determine the flue gas moisture and thoroughly dry the gas. The sample gas then flows into a calibrated dry gas meter where the collected sample gas volume is determined.

The sampling system traverses all of the Method 1 points during each run. A minimum volume of 0.9 dry standard cubic meters (dscm), or 31.8 dry standard cubic feet (dscf), will be sampled during each 60-minute run.

METHODOLOGY

O_2, CO_2, and VOC Testing - USEPA Methods 3A, 18, and 25A

O_2 and CO_2 emissions will be determined using a paramagnetic/NDIR CEMs analyzer per USEPA Method 3A. VOC emissions will be determined using USEPA Method 25A to quantify total hydrocarbon emissions (THC) and USEPA Method 18 to quantify methane (CH_4) and ethane (C_2H_6) emissions. VOC emissions are equivalent to THC emissions, minus CH_4 and C_2H_6 emissions.

The M-3A/18/25A sampling system consists of a heated probe, heated filter and heated sample line. Flue gas is extracted at a constant rate and delivered at 250°F to a tee at the end of the heated sample line.

- One leg of the tee is connected to a flame ionization analyzer (FIA) which continuously measures minute-average THC concentration expressed in terms of propane (C_3H_8) on an actual (wet) basis.
- The other leg of the tee is connected to a gas conditioner which removes moisture before delivering the gas to a flow panel and the O_2/CO_2 analyzers, which measures concentration on a dry basis (units of %dv or ppmdv).
- The M-18 gas sample is collected by pulling a slipstream from the flow panel and delivering it into a Tedlar bag at a constant rate. The moisture condensate is not collected for analysis as CH_4 and C_2H_6 are insoluble in water. Each bag is filled over a period of one (1) hour for each test run.

THC analyzer calibrations are performed by introducing zero air, high, mid- and low-range C_3H_8 calibration gases to the inlet of the sampling system's heated filter. Bias checks are performed before and after each sampling run in a similar manner.

O_2 / CO_2 calibration error checks are performed by introducing zero nitrogen (N_2), high-range and mid-range calibration gases to the inlet of each analyzer during calibration error checks. Bias checks are performed before and after each sampling run by introducing calibration gas to the inlet of the sampling system's heated filter. Per M-3A, the average results for each run will be drift-corrected.

Analysis for CH_4 and C_2H_6 will be performed off-site using gas chromatography (GC). Since moisture is removed from the sample prior to collection and GC analysis, the concentration results will be on a dry basis.

METHODOLOGY

HCN Testing – USEPA OTM-29

HCN emissions will be determined using OTM-29 and an isokinetic, multi-point sample train. The sampling system consists of a nozzle, heated probe, heated quartz filter, impinger train (for HCN collection and H_2O removal/measurement) and a dry gas meter. The HCN-collecting impingers are charged with 6.0 N sodium hydroxide (NaOH) solution.

The sampling system will traverse all of the Method 1 points during each run. A maximum volume of 0.9 dry standard cubic meters (dscm), or 31.8 dry standard cubic feet (dscf), will be sampled during each one-hour run. The pH in the final impinger containing absorbing solution should be maintained >12.0 throughout the test.

The sample train will be recovered per OTM-29 requirements. The front-half portion of the sample train (nozzle, probe and heated filter) is not recovered or analyzed. The back-half of the heated filter outlet is also not recovered or analyzed. Prior to recovery, the pH of each impinger preceding the final impinger is measured and adjusted to > 12.0 if necessary. The impinger fractions are then recovered per the method (Impingers #1 and #2 recovered together, Impinger #3 recovered separately).

A field train blank will be assembled, transported to the location, heated, leak-checked and recovered as if it were an actual test sample. A field spike sample will be collected by introducing a spike standard into a single impinger containing absorbing reagent and recovering the impinger following standard procedures. Reagent blanks will be collected to quantify background contamination. All samples will be stored under refrigeration or cold packs prior to analysis. Samples and blanks will be shipped to a lab off site and analyzed by ion chromatography (IC).

H_2SO_4 Testing - Draft ASTM Controlled Condensation Method

H_2SO_4 emissions will be determined referencing the Draft ASTM Controlled Condensation Method.

A gas sample is extracted from the source at a constant flow rate using a quartz-lined probe maintained at 650°F and a quartz fiber filter maintained at 650°F to remove particulate matter.

METHODOLOGY

The sample then passes through a glass coil condenser for collection of sulfuric acid vapor and/or mist. A second quartz fiber filter (referred to as the sulfuric acid mist (SAM) filter) located at the condenser outlet collects any residual sulfuric acid mist that passed through the condenser. The condenser temperature is regulated by a circulating water jacket; the SAM filter temperature is regulated by a closed oven. Both the water jacket and SAM filter oven are maintained at 140°F ±9°F, which eliminates the oxidation of dissolved SO_2 into the H_2SO_4-collecting fraction of the sample train.

After exiting the SAM filter, the sample gas then continues through a series of four (4) glass knock-out jars; two (2) containing water, one (1) empty, and one (1) containing silica gel for residual moisture removal. The exit temperature from the knock-out jar set is maintained below 68°F. The sample gas then flows into a calibrated dry gas meter where the collected sample gas volume was determined.

The H_2SO_4-collecting portion of the sample train (condenser and SAM filter) is recovered into a single fraction using DI H_2O as the recovery/extraction solvent; any H_2SO_4 disassociated into sulfate ion (SO_4^{2-}) is stabilized in the H_2O matrix until analysis.

Prior to the first official test run, a 60-minute sample conditioning run will be performed in order to minimize the absorption capacity of the front-half components of the sample train (upstream of the H_2SO_4-collecting portion of the sample train). The conditioning run is recovered in the same manner as the official test runs, but the condenser rinse and SAM filter are not analyzed.

A field train blank will be assembled, transported to the location, heated, leak-checked and recovered as if it were an actual test sample. Reagent blanks will be collected to quantify background contamination.

Samples and blanks will be returned to CleanAir Analytical Services for ion chromatography (IC) analysis.

End of Section 3 – Methodology

APPENDIX

4-1

TEST METHOD SPECIFICATIONS ..... A
SAMPLE CALCULATIONS ..... B
RESUMES C

TEST METHOD SPECIFICATIONS

A

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified accurate.

QA/QC Initials: _____

Date: _____

CleanAir

Specification Sheet for EPA Method 5/202

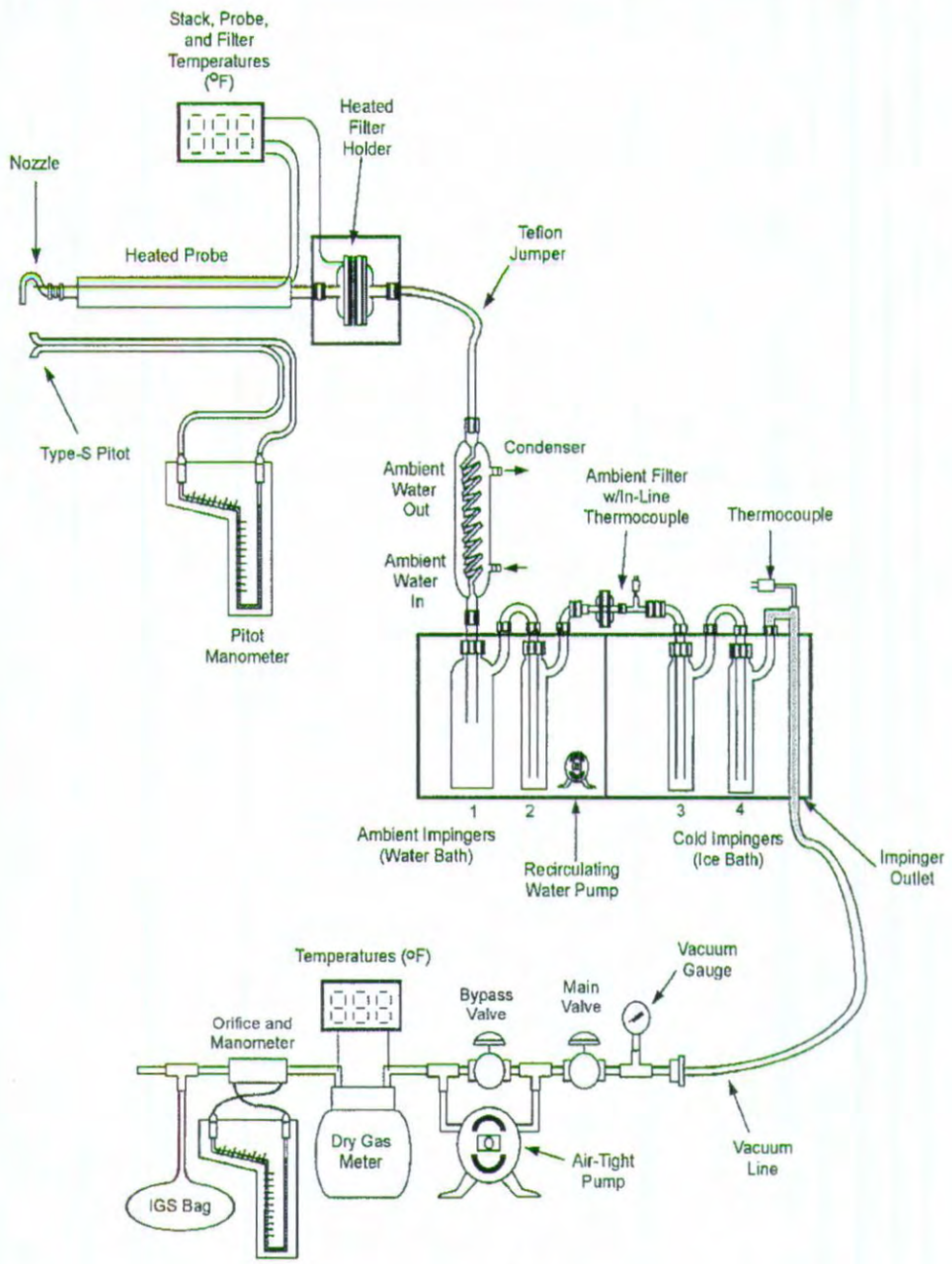
Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	Filterable Particulate Matter (FPM) and Condensable Particulate Matter (CPM)
Other Parameters to be Determined from Train	Gas Density, Moisture, Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	24
Sample Time per Point	N/A	2.5 minutes
Sampling Rate	Isokinetic (90-110%)	Isokinetic (90-110%)
Sampling Probe		
Nozzle Material	Stainless Steel or Glass	Borosilicate Glass
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Glass or Teflon	Borosilicate Glass
Effective Probe Length	N/A	TBD
Probe Temperature Set-Point	248°F±25°F	248°F±25°F
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	N/A	TBD
Pitot Tube Calibration by	Geometric or Wind Tunnel	Geometric
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
FPM Filter Description		
Filter Location	After Probe	Exit of Probe
Filter Holder Material	Quartz	Borosilicate Glass
Filter Support Material	Glass Frit	Teflon
Cyclone Material	N/A	None
Filter Heater Set-Point	248°F±25°F	248°F±25°F
Filter Material	Glass Fiber	Quartz Fiber
Other Components		
Description	Condenser	Condenser
Location	Before Impinger 1	Before 1st Impinger
Operating Temperature	≤85°F	≤85°F

Specification Sheet for EPA Method 5/202

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Leak-Free Glass Connectors	Screw Joint with Silicone Gasket
Connection to Probe or Filter by	Direct or Flexible Connection	Flexible Teflon Line
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Shortened Stem (open tip)	Shortened Stem (open tip)
Impinger 2	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 3	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 4	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 5		
Impinger 6		
Impinger 7		
Impinger 8		
CPM Filter Description		
Filter Location	Between 2nd and 3rd Impingers	Between 2nd and 3rd Impingers
Filter Holder Material	Glass, Stainless Steel or Teflon	Borosilicate Glass
Filter Support Material	Teflon	Teflon
Cyclone Material	None	None
Filter Heater Set-Point	>65°F but ≤85°F	>65°F but ≤85°F
Filter Material	Teflon Membrane	Teflon Membrane
Gas Density Determination		
Sample Collection	Multi-point integrated	Multi-Point Integrated
Sample Collection Medium	Flexible Gas Bag	Vinyl Bag
Sample Analysis	Orsat or CEM Analyzer	CEM
Sample Recovery Information		
Nozzle Brush Material	Nylon Bristle or Teflon	Nylon Bristle
Nozzle Rinse Reagent	Acetone	Acetone
Nozzle Rinse Wash Bottle Material	Glass or Polyethylene	Inorganic in polyethylene, organic in Teflon
Nozzle Rinse Storage Container	Glass or Polyethylene	Glass
Filter Recovered?	Yes	Yes
Filter Storage Container	FH filter in petri dish, CPM filter in petri dish	FH filter in petri dish, CPM filter in petri dish
Impinger Contents Recovered?	Yes	Yes
Impinger Rinse Reagent	DI Water/Acetone/Hexane	DI Water/Acetone/Hexane
Impinger Wash Bottle	Inorganic in polyethylene, organic in Teflon	Inorganic in polyethylene, organic in Teflon
Impinger Storage Container	Inorganic in polyethylene, organic in glass	Inorganic in amber glass, organic in amber glass
Analytical Information		
Method 4 H_2O Determination by	Volumetric or Gravimetric	Gravimetric and Volumetric
Filter Preparation Conditions	Dessicate 24 Hours or Filter Extraction	See Analytical Flow Chart
Front-Half Rinse Preparation	Evaporate at ambient temperature and pressure	Evaporate at ambient temperature and pressure
Back-Half Analysis	Sonication and Extraction	See Analytical Flow Chart
Additional Analysis	N/A	None

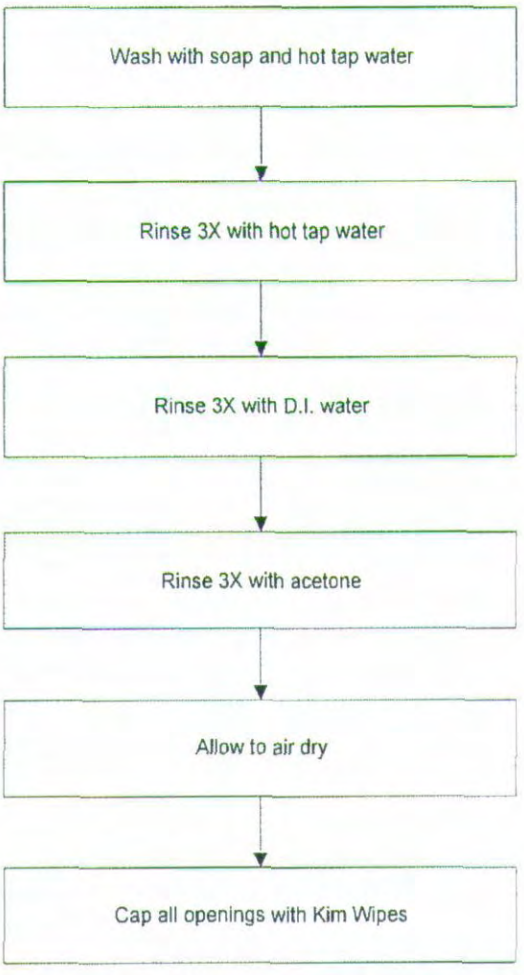
EPA Method 5/202
Sampling Train Configuration



Impinger Contents

Impinger 1	Empty
Impinger 2	Empty
Impinger 3	DI H_2O
Impinger 4	Silica Gel

EPA Method 5
Glassware Preparation Procedures



EPA Method 5
Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)

Container 1
Quartz Filter
Petri Dish

Remove with tweezers to original container. Brush any loose particulate or filter fibers into sample container

If necessary fold in half and place into container

Visual Inspection

Container 2
Front Half (FH) Rinse
250 ml Glass

Probe liner, nozzle, cyclone or cyclone bypass and filter FH

Brush/rinse 3X with acetone (6X for metal components)

Visual Inspection

Label container and measure volume by weight

Container 3
Silica Gel

Measure volume by weight, note any color change

Recycle silica gel

*Containers 4 and 7 are required when the testing includes a back half analysis

Container 4*
Back Half (BH) Rinse
500 ml Plastic

BH filter housing, Z-piece, impingers 1, 2, 3 and U-Bends

Measure volume by weight

Empty contents into labeled container

Rinse with water

Visual Inspection

Label container and measure volume by weight

Blanks

Container 5
Filter Blank
Plastic Petri Dish

Clean, unused tared filter

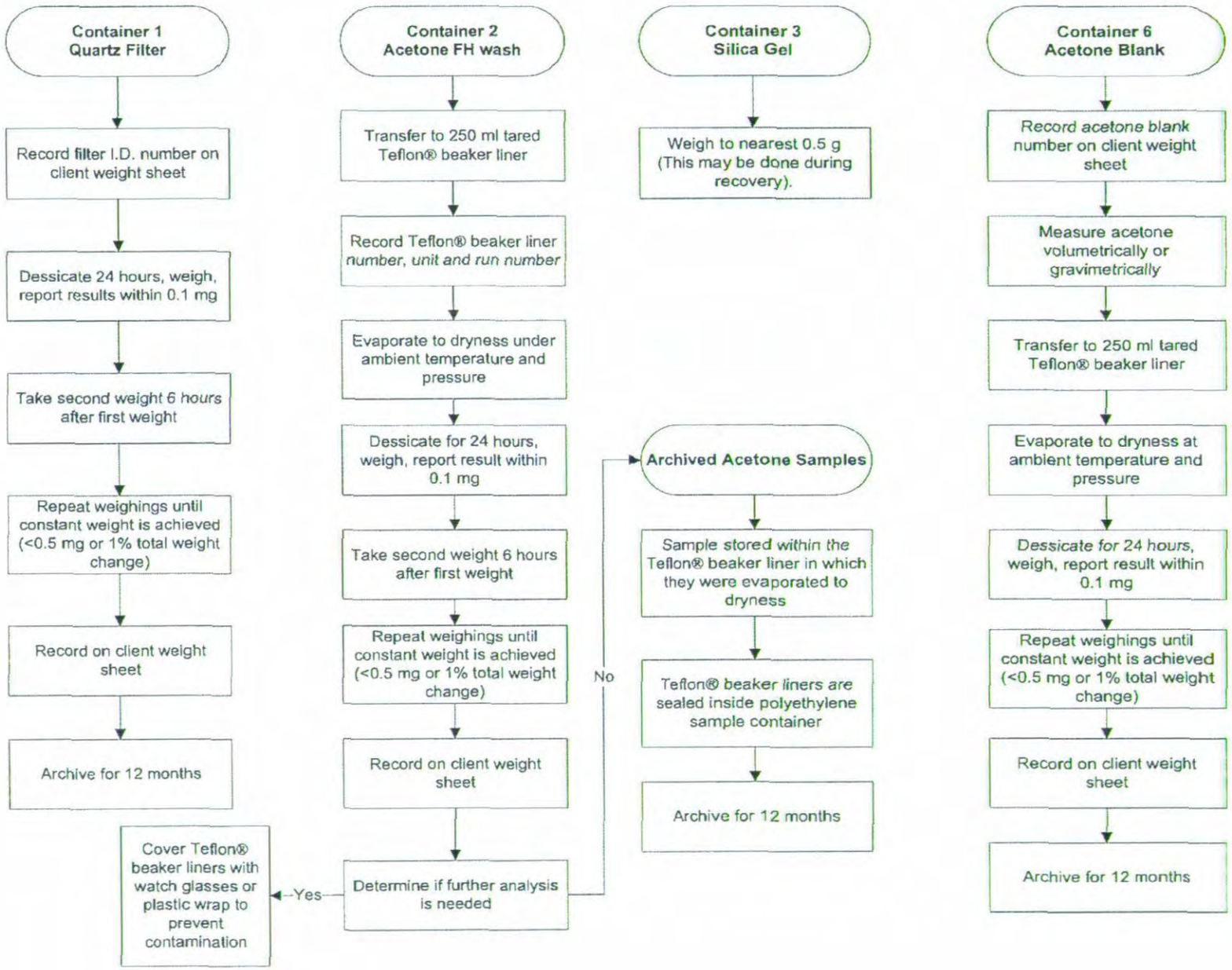
Container 6
Acetone Blank
250 ml Glass

200 ml of acetone from rinse bottle. Record lot number

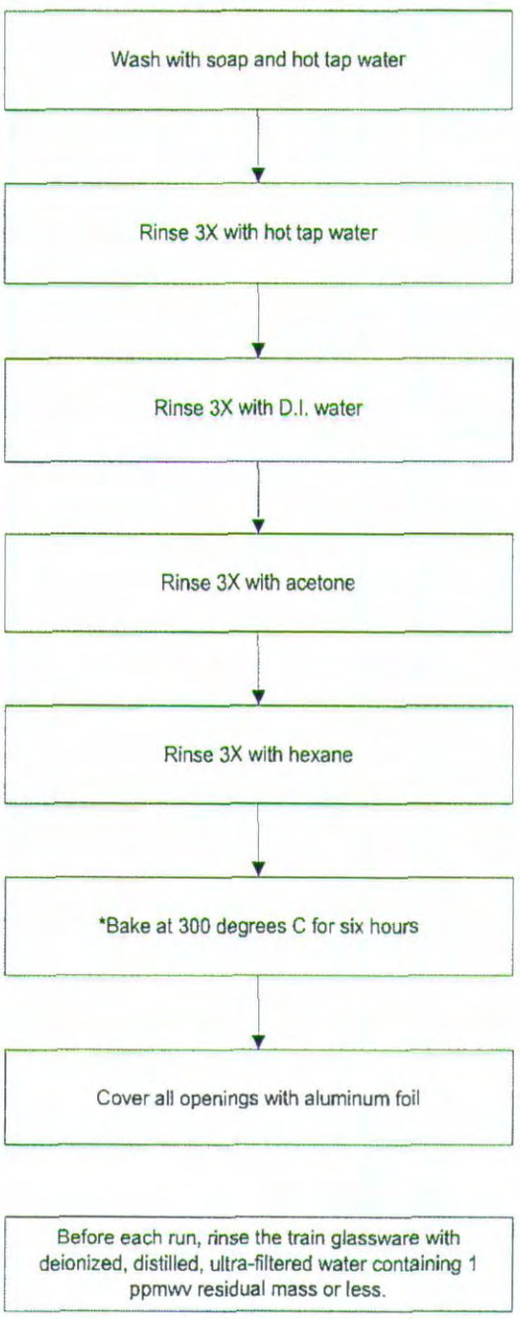
Container 7*
D.I. Water Blank
250 ml Plastic

200 ml of water from rinse bottle

EPA Method 5
Analytical Flowchart



EPA Method 202
Glassware Preparation Procedures



*As an alternative to baking glassware, a field train proof blank can be performed on the sampling train glassware.

EPA Method 202
Sample Recovery Flowchart (1 of 2)

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degreesC)
- Samples must be maintained at or below 85 degrees F (30 degrees C) during shipping.

Post-Test N2 Purge*

Transfer water collected in condenser and water dropout impinger to back-up impinger; measure and record volume or weight

Conduct purge on condenser, back-up impinger and CPM filter with N2 at 14 LPM for one hour

Purge Notes:

- *Continue operating condenser recirculation pump and maintain gas temperature at exit of CPM filter >65°F but ≤85°F.*
- *If volume of water in moisture traps was not determined prior to purge, maintain trap temperature and keep gas temperature at exit of silica gel impinger below 68°F.*
- *At conclusion of purge, simultaneously turn off delivery and pumping systems.*
- *For high moisture sampling, weigh and change out silica gel prior to purging.*

CPM Container 1
Inorganic Rinse
950 ml Amber Glass

Back-half FPM filter holder, probe extension, condenser, dropout and back-up impingers, connecting glassware, front-half CPM filter holder

Measure and record impinger volume by weight

Empty contents into labeled container

Rinse 2X with deionized, distilled, ultra-filtered water and add to sample container

Visual Inspection

Mark liquid level and label container

CPM Container 2
Organic Rinses
950 ml Amber Glass

Back-half FPM filter holder, probe extension, condenser, dropout and back-up impingers, connecting glassware, front-half CPM filter holder

Rinse 1X with acetone and add to sample container

Rinse 2X with hexane and add to sample container

Visual Inspection

Mark liquid level and label container

CPM Container 3
Filter Sample
Petri Dish

CPM filter

Use tweezers and/or disposable surgical gloves to remove CPM filter and place in Petri dish

Visual Inspection

Label container

CPM Container 4**
Cold Impinger Water
500 ml Plastic

Cold impinger that follows the CPM filter

Quantitatively transfer liquid into sample container

Visual Inspection

Mark liquid level and label container

****If the water has been weighed in the field, it can be discarded.

CPM Container 5
Silica Gel

Measure volume by weight, note any color change

Recycle silica gel

EPA Method 202
Sample Recovery Flowchart (2 of 2)

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)
- Samples must be maintained at or below 85 degrees F (30 degrees C) during shipping.

CPM Container 6 Acetone Field Reagent Blank

Collect 200 ml of acetone from wash bottle into amber glass container

Visual inspection

Mark liquid level and label container

Collect one acetone blank for each lot of solvent used

CPM Container 7 Water Field Reagent Blank

Collect 200 ml of water from wash bottle into amber glass container

Visual inspection

Mark liquid level and label container

Collect one water blank for each lot used

CPM Container 8 Hexane Field Reagent Blank

Collect 200 ml of hexane from wash bottle into amber glass container

Visual inspection

Mark liquid level and label container

Collect one hexane blank for each lot of solvent used

CPM Container 9 Field Train Proof Blank* Inorganic Rinses

Prior to testing, rinse probe extension, condenser, impingers, connecting glassware and front-half CPM filter housing 2X with water

Collect rinses in plastic sample container

Visual inspection

Mark liquid level and label container

If glass ware was not baked a field train proof blank must be performed to demonstrate the cleanliness of the glassware. Baking the glassware is a CleanAir SOP

CPM Container 10 Field Train Proof Blank* Organic Rinses

After rinsing with water, rinse probe extension, condenser, impingers, connecting glassware and front-half CPM filter housing with acetone

Repeat procedure by rinsing 2X with hexane

Collect both rinses in amber glass container

Visual inspection

Mark liquid level and label container

Field Train Blank (required)

A minimum of one field train blank for each source category tested at facility is required.

Recover field blank after first or second run

Assemble sampling train as it would be used for testing.

Prior to purge, add 100 ml water to first impinger and record data

Purge train and recover blank samples as described on Page 1 of 2

From field sample weight, subtract condensable particulate mass determined from blank train or 0.002 g, whichever is less.

EPA Method 202
Analytical Flowchart (1 of 2)

- Log each sample in shipment and verify against chain-of-custody sheet
- Note liquid levels in the sample containers and confirm on the chain-of-custody sheet condition

CPM Container 1 Inorganic Rinse

Measure liquid volumetrically or gravimetrically

Transfer inorganic contents into separatory funnel and add 30 ml of hexane

Drain off lower inorganic phase into a clean sample *container or beaker*

Drain off organic phase into a separate clean sample container or beaker, leaving a small amount of hexane in funnel

Repeat procedure twice with 30 ml hexane, combining the organic phase with each extraction

Inorganic Extraction

Transfer inorganic fraction from extraction into 250 ml tared Teflon® beaker liner

Evaporate to no less than 10 ml on a hot plate or in 105 degree C oven

Allow to dry at room temperature (not to exceed 85 degrees F). Ensure the water and volatile acids have completely evaporated before neutralizing nonvolatile acids in sample

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

No constant weight

Redissolve residue in 100 ml of deionized, distilled ultra-filtered water

Titrate sample with 0.1 N NH_4OH to a pH of 7.0, record volume of titrant used.

Evaporate to no less than 10 ml using hot plate or 105 degree C oven

Allow to dry at room temperature (not to exceed 85 degrees F)

Organic Extraction

The extraction should yield around 90 ml of organic extract

Combine the organic extract of Container 1 with the organic train rinse in Container 2

CPM Container 2 Organic Rinses

Measure liquid volumetrically or gravimetrically

Transfer contents into 250 ml tared Teflon® beaker liner

Evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

CPM Container 3 Filter Sample

Was sample collected by Method 17 or 201A with a stack temp < 85°F? Can the filter be brought to constant weight?

Yes

Transfer filter and loose PM from sample container to tared glass weighing dish

Dessicate for 24 hours

Weigh to constant weight and report results to nearest 0.1 mg

No

Extract the filter

Inorganic Extraction

Fold filter into quarters and place in 50 ml extraction tube

Add 10 ml deionized, distilled ultra-filtered water to extraction tube (or sufficient to cover the filter)

Extract for at least 2 minutes in sonication bath; add to separate inorganic fraction Container 1

Repeat extraction twice more for a total of three extractions; add to Container 1

Organic Extraction

Add 10 ml hexane to extraction tube (or sufficient to cover the filter)

Extract for at least 2 minutes in sonication bath; add to separate organic fraction Container 2

Repeat extraction twice more for a total of three extractions; add to Container 2

EPA Method 202
Analytical Flowchart (2 of 2)

- Log each sample in shipment and verify against chain-of-custody sheet
- Note liquid levels in the sample containers and confirm on the chain-of-custody sheet condition

CPM Container 4*
Cold Impinger Water

Measure liquid volumetrically or gravimetrically

CPM Container 5*
Silica Gel

Weigh to nearest 0.5 g

*May have been performed in the field during sample recovery

CPM Container 6
Acetone Field Reagent Blank

Transfer 150 ml of acetone to 250 ml tared Teflon® beaker liner and evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

CPM Container 7
Water Field Reagent Blank

Transfer 150 ml of water to 250 ml tared Teflon® beaker liner and evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

CPM Container 8
Hexane Field Reagent Blank

Transfer 150 ml of hexane to 250 ml tared Teflon® beaker liner and evaporate to dryness at room temperature (not to exceed 85 degrees F)

Dessicate for 24 hours

Weigh at intervals of 6 hours to constant weight and report results to nearest 0.1 mg

Specification Sheet for Draft ASTM Controlled Condensation Method (CCM)

Source *Location Name(s)*	FCCU Regenerator Stack
Pollutant(s) to be Determined	Sulfuric Acid (H_2SO_4)
Other Parameters to be Determined from Train	None

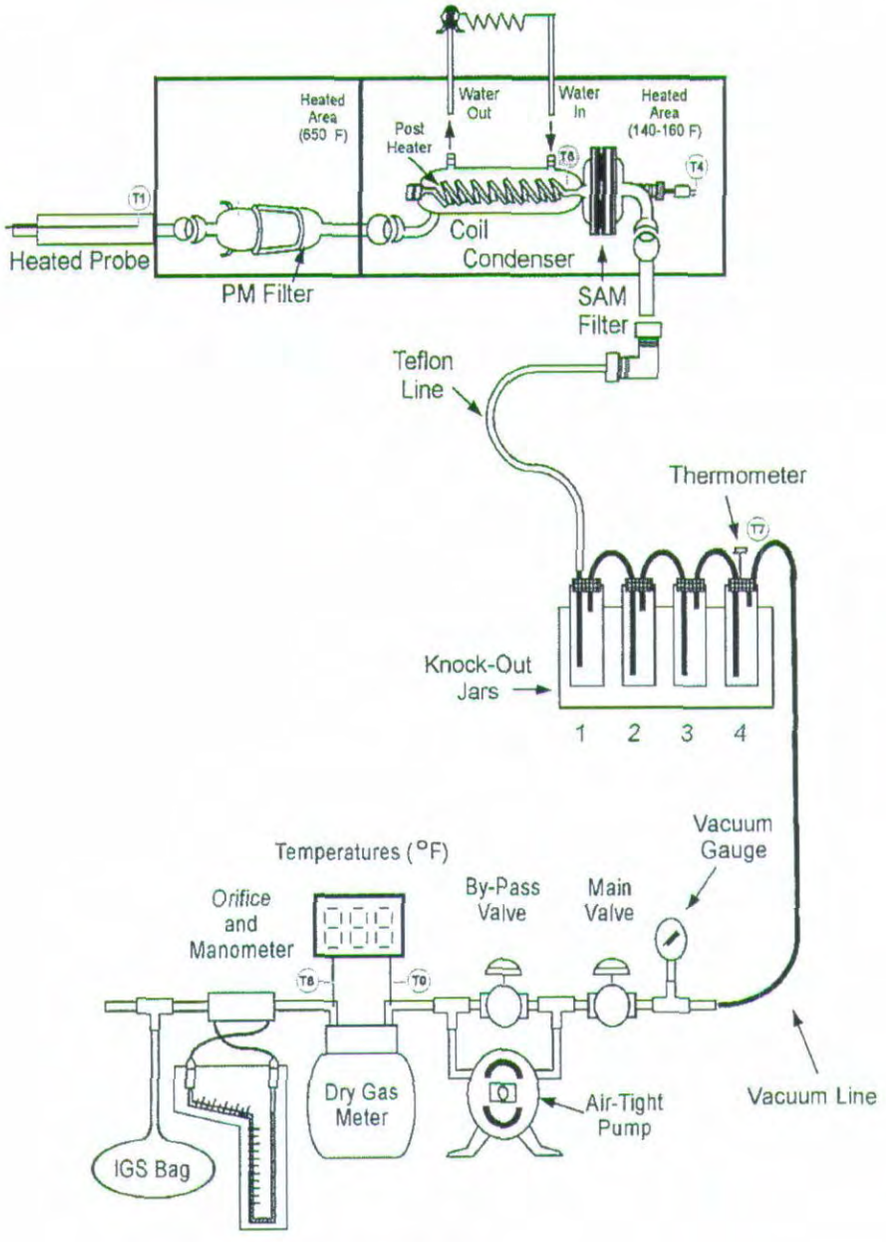
	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	60 minutes	60 minutes
No. of Sample Traverse Points	1	1
Sample Time per Point	60 minutes	60 minutes
Sampling Rate	Constant rate of 10.0 Lpm ±10%	Constant rate of 13.0 Lpm ±10%
Sampling Probe		
Nozzle Material	N/A	None
Nozzle Design	N/A	N/A
Probe Liner Material	Borosilcate Glass	Quartz
Effective Probe Length	N/A	TBD
Probe Temperature Set-Point	650°F	650°F±25°F
Velocity Measuring Equipment		
Pitot Tube Design	N/A	None
Pitot Tube Coefficient	N/A	N/A
Pitot Tube Calibration by	N/A	N/A
Pitot Tube Attachment	N/A	N/A
Metering System Console		
Meter Type	Dry gas meter or controlled orifice	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	N/A	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	±5°F	1.0°F
ΔP Differential Pressure Gauge	N/A	N/A
ΔH Differential Pressure Gauge	N/A	Inclined Manometer
Barometer	Capable of measurement within 0.1 in. Hg	Digital Barometer calibrated w/Mercury Aneroid
Particulate (PM) Filter		
Filter Location	Exit of Probe	Exit of Probe
Connection to probe liner by	Direct glass-to-glass	Direct Quartz-to-Quartz
Filter Holder Material	Quartz	Quartz
Filter Support Material	Glass frit	Quartz
Cyclone Material	N/A	None
Filter Heater Set-Point	Same as probe set-point	650°F±25°F
Filter Material	Quartz Fiber	Quartz Fiber
Filter Conditioning	Pre-rinsed w 0.1N H_2SO_4; baked at 600°F	Pre-rinsed w 0.1N H_2SO_4; baked at 600°F
SO_3 Coil condenser		
Description	Condenser Coil (10 coils) with water jacket	Condenser Coil (10 coils) with water jacket
Location	After PM Filter	After PM filter
Connection to PM Filter by	Direct glass-to-glass	Ground Glass with Silicone O-Ring
Water Jacket	Temperature regulated water jacket surrounding coil condenser	Temperature regulated water jacket surrounding coil condenser
Operating Temperature	Sufficient to maintain SAM filter at 140°F±9.0°F	140°F±9.0°F

Specification Sheet for Draft ASTM Controlled Condensation Method (CCM)

Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	Sulfuric Acid (H_2SO_4)
Other Parameters to be Determined from Train	None

	Standard Method Specification	Actual Specification Used
Sulfuric Acid Mist (SAM) Filter		
Description	Sulfuric Acid Mist (SAM) Filter	High Purity Quartz Fiber Filter (QMA)
Location	After Condenser Coil	After Condenser Coil
Connection to SO_3 Condenser Coil by	Direct glass-to-glass	Condenser/SAM filter holder combination (ie single piece)
Operating Temperature	140°F±9.0°F	140°F±9.0°F
Impinger Train Description		
Type of Glassware Connections	Ground Glass	Flexible Rubber Line
Connection to SAM Filter by	Direct glass-to-glass	Flexible Teflon Line
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Midget or Full size impinger	Knock-Out Jar
Impinger 2	Midget or Full size impinger	Knock-Out Jar
Impinger 3	Midget or Full size impinger	Knock-Out Jar
Impinger 4	Midget or Full size impinger	Knock-Out Jar
Impinger 5		
Impinger 6		
Impinger 7		
Gas Density Determination		
Sample Collection	N/A	Single Point Integrated
Sample Collection Medium	N/A	Vinyl Bag
Sample Analysis	N/A	CEM
Sample Recovery Information		
Probe Brush Material	N/A	N/A
Probe Rinse Reagent	N/A	N/A
Probe Rinse Wash Bottle Material	N/A	N/A
Probe Rinse Storage Container	N/A	N/A
PM Filter Recovered?	No	Yes
PM Filter Storage Container	N/A	Polyethylene
SO_3 Condenser Contents Recovered?	Yes	Yes
SO_3 Condenser Rinse Reagent	Sulfate-free water	DI Water
SO_3 Condenser Wash Bottle	Polyethylene	Polyethylene
SO_3 Condenser Storage Container	Polyethylene	Polyethylene
SAM Filter Recovered?	Yes	Yes, placed into SO_3 condenser storage container
SAM Filter Storage Container	Polyethylene	Polyethylene
Impinger Contents Recovered?	Optional	No
Impinger Rinse Reagent	Sulfate-free water	N/A
Impinger Wash Bottle	Polyethylene	N/A
Impinger Storage Container	Polyethylene	N/A
Analytical Information		
Method 4 H_2O Determination by	Gravimetric	Concurrent M5/202 sample run
SO_3 Condenser/SAM Filter Analysis	Ion chromatography for sulfate	Ion chromatography for sulfate
Impinger Analysis (SO_2)	Ion Chromatography or Titration for sulfate (optional)	N/A
PM Filter Analysis	PM Filter - Not recovered	Not analyzed

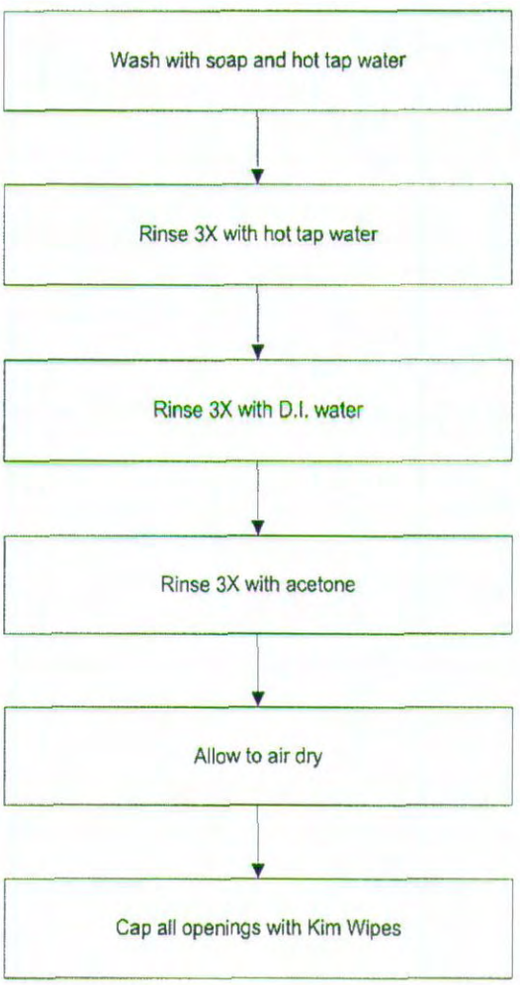
Draft ASTM CCM
Sampling Train Configuration



Impinger Contents

Impinger 1	DI H_2O
Impinger 2	DI H_2O
Impinger 3	Empty
Impinger 4	Silica Gel

Draft ASTM Controlled Condensation Method
Glassware Preparation Procedures



Draft ASTM Controlled Condensation Method Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)

Container 0
Condenser Rinse
Pre-Test Proof
100ml HDPE

Prior to Run 1, rinse condenser with approximately 50ml of DI water and collect in sample container

Label, seal and mark liquid level of container

Condition condenser with 50ml of 100% IPA

Container 2A
Particulate Catch
(Optional Ash Analysis)
Quartz Filter
Glass Petri Dish

None performed; filter and particulate catch may be discarded.

Container 1
Condenser Rinse
100ml HDPE

Rinse condenser a minimum of 3X with approximately 50ml DI water and collect rinse in sample container

Place SAM filter in container and brush any loose particulate into sample container

Label, seal and mark liquid level of container

Container 2B
Probe Rinse
(Optional Ash Analysis)
100 ml HDPE

None performed; filter and particulate catch may be discarded.

Container 3
Knock-Out Jars 1-3
(Water)

Walk lines if necessary, while pulling ambient air to remove moisture from long sample lines

Measure volume or weight from jars

Discard or reuse water

Container 4
Knock-Out Jar 4
(Silica Gel)

Measure volume by weight to nearest 0.5g and note any color change

Recycle silica gel

Container 5
Final Condenser Rinse
Post-Test Proof
100ml HDPE

Rinse condenser a minimum of 3X with approximately 50ml DI water and collect rinse in sample container

Label, seal and mark liquid level of container

Condition condenser with 50ml of 100% IPA

Blanks

Container 6
DI Water Blank
250ml Plastic

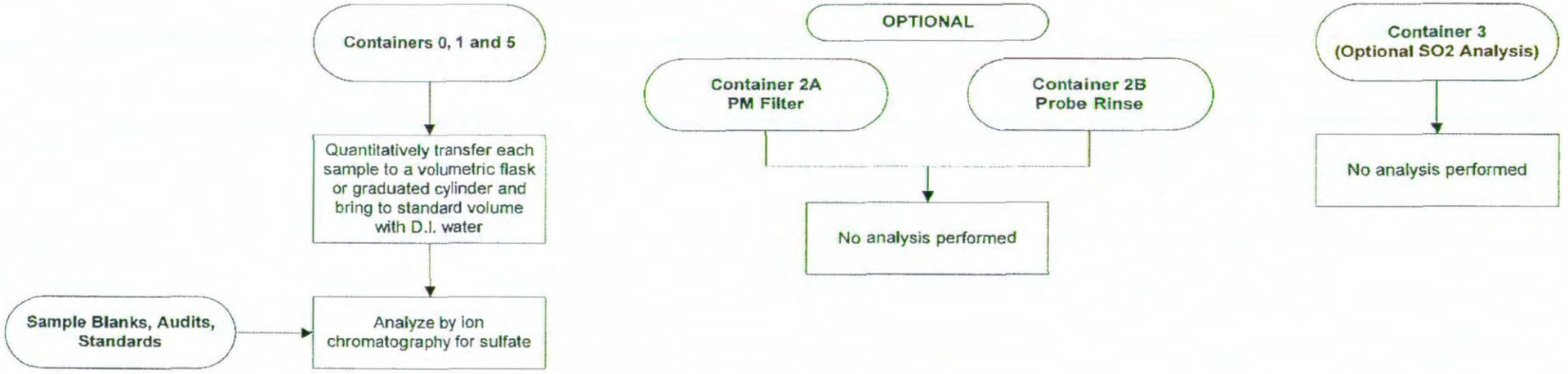
200ml of DI water

Container 7
3% Hydrogen Peroxide
Blank (Optional Sulfur
Dioxide Analysis)
250ml HDPE

200ml of 3% H2O2

Draft ASTM Controlled Condensation Method Analytical Flowchart

- Log each sample in shipment and verify against chain-of-custody sheet
- Note liquid levels in the sample containers and confirm on the chain-of-custody sheet condition



Specification Sheet for Other Test Method 29

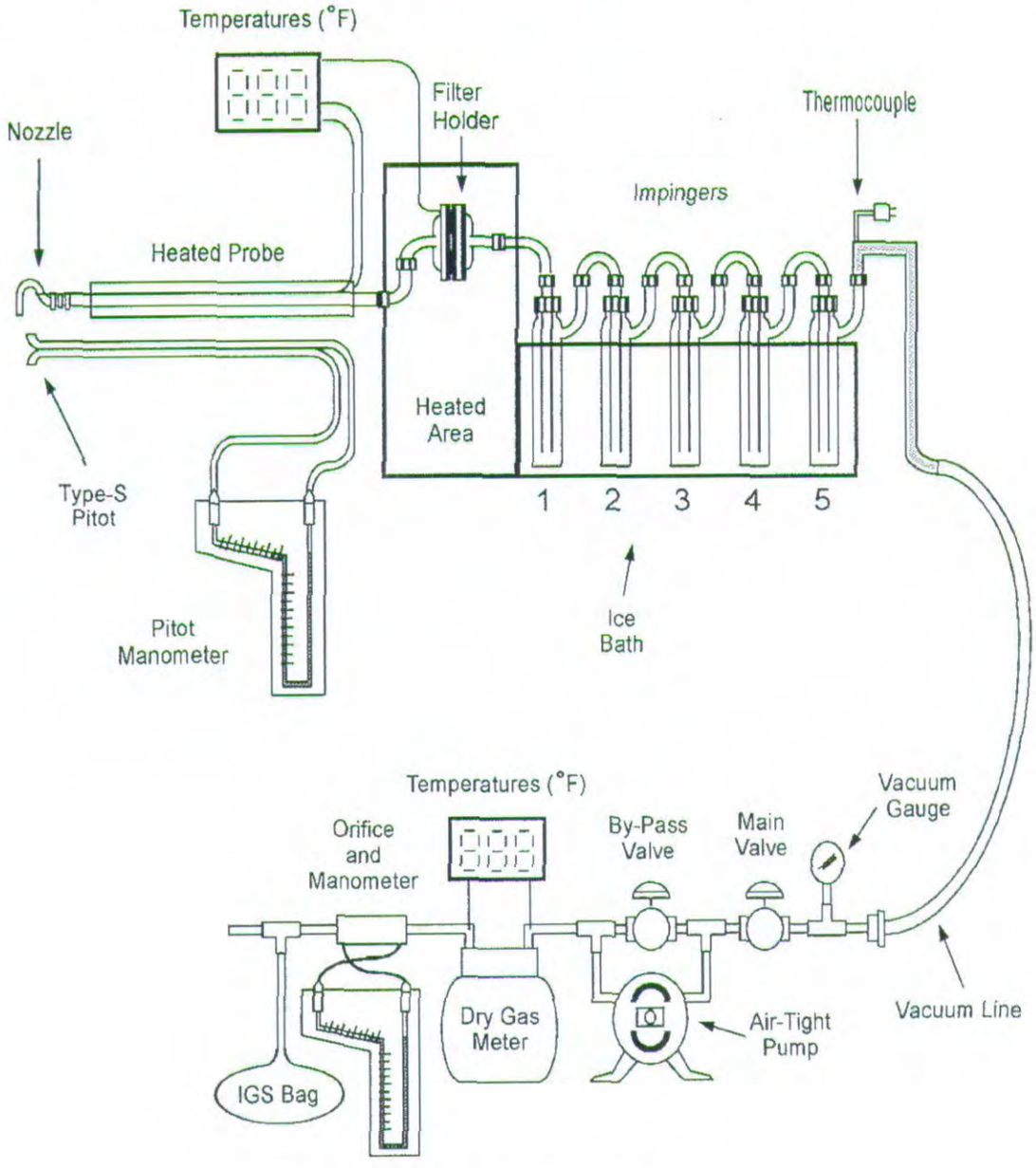
Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	Hydrogen Cyanide
Other Parameters to be Determined from Train	Gas Density, Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	24
Sample Time per Point	N/A	2.5 minutes
Sampling Rate	Isokinetic (90-110%)	Isokinetic (90-110%)
Sampling Probe		
Nozzle Material	Borosilicate or Quartz Glass	Borosilicate Glass
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Borosilicate or Quartz Glass	Borosilicate Glass
Effective Probe Length	N/A	TBD
Probe Temperature Set-Point	248°F ± 25°F	248°F±25°F
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	Known coefficient	TBD
Pitot Tube Calibration by	Geometric or Wind Tunnel	Wind-Tunnel
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±2%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	5.4°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	After Probe	Exit of Probe
Filter Holder Material	Borosilicate, Quartz Glass	Borosilicate Glass
Filter Support Material	Teflon	Teflon
Cyclone Material	NA	None
Filter Heater Set-Point	248°F ± 25°F	248°F±25°F
Filter Material	Quartz or Fluoropolymer Coated Fiber Filter	Quartz Fiber
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

Specification Sheet for Other Test Method 29

	Standard Method Specification	Actual Specification Used
Impinger Train Description		
Type of Glassware Connections	Ground Glass or Equivalent	Ground Glass with Silicone O-Ring
Connection to Probe or Filter by	Direct Glass Connection	Direct Glass Connection
Number of Impingers	4 or 5	5
Impinger Stem Types		
Impinger 1	Greenburg-Smith	Modified Greenburg-Smith
Impinger 2	Greenburg-Smith	Modified Greenburg-Smith
Impinger 3	Greenburg-Smith	Modified Greenburg-Smith
Impinger 4	Greenburg-Smith	Modified Greenburg-Smith
Impinger 5	Modified Greenburg-Smith	Modified Greenburg-Smith
Impinger 6		
Impinger 7		
Impinger 8		
Gas Density Determination		
Sample Collection	Multi-point Integrated	Multi-Point Integrated
Sample Collection Medium	Flexible Gas Bag	Direct Interface
Sample Analysis	Orsat or Fyrite Analyzer	CEM
Sample Recovery Information		
Probe Brush Material	Teflon Bristle	Teflon Bristle
Probe Rinse Reagent	Acetone	Acetone
Probe Rinse Wash Bottle Material	Teflon or glass	Teflon
Probe Rinse Storage Container	N/A	Glass
Filter Recovered?	Yes (for PM analysis only)	No
Filter Storage Container	N/A	Polyethylene
Impinger Contents Recovered?	Yes	Yes
Impinger Rinse Reagent	0.1N NaOH	0.1 N Sodium Hydroxide
Impinger Wash Bottle	Glass or Polyethylene	Polyethylene
Impinger Storage Container	Alkali resistant polyethylene or glass	Polyethylene
Analytical Information		
Method 4 H_2O Determination by	Separate EPA Method 4 Sampling Train	Gravimetric
Filter Preparation Conditions	See Analytical Flowchart	See Analytical Flow Chart
Front-Half Rinse Preparation	See Analytical Flowchart	See Analytical Flow Chart
Back-Half Analysis	Ion Chromatography	Ion Chromatography
Additional Analysis	None	None

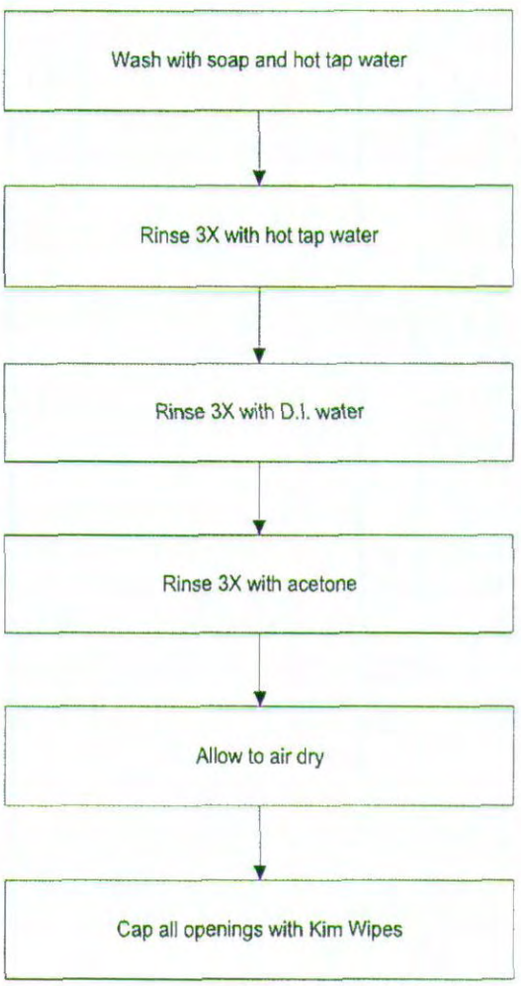
Other Test Method 29
Sampling Train Configuration



Impinger Contents

Impinger 1	200 mL 6N NaOH
Impinger 2	200 mL 6N NaOH
Impinger 3	200 mL 6N NaOH
Impinger 4	100 mL 6N NaOH
Impinger 5	Silica Gel

Other Test Method 29
Glassware Preparation Procedures



Other Test Method 29
Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape

Container 1
Front half (FH) particulate rinse (optional)
250 ml Glass

Probe nozzle, probe fitting, probe liner, FH filter holder and FH connecting glassware

Brush/rinse components 3X with acetone. Add to sample container

Seal, label and mark liquid level

Container 2
Filter catch for particulate determination (optional)

Remove with tweezers to original container. Brush any loose particulate or filter fibers to sample container

If necessary fold in half and place into container

Visual Inspection

Container 3
Impinger Catch
500 ml Polyethylene

Impingers 1, 2, 3 and connecting glassware

Record pH. Measure and record volume by weight

Quantitatively transfer liquid to sample container

Rinse impingers and connecting glassware 3X with 0.1N NaOH. Add to sample container

DO NOT RINSE THE BH FILTER HOLDER

Seal, label and mark liquid level

Container 4
Impinger Catch
500 ml Polyethylene

Impinger 4 and connecting glassware

Record pH. Measure and record volume by weight

Quantitatively transfer liquid to sample container

Rinse impingers and connecting glassware 3X with 0.1N NaOH. Add to sample container

Seal, label and mark liquid level

Container 5
Silica Gel

Weigh the spent silica gel to the nearest 0.5 grams

Recycle silica gel

Container 6
6N NaOH Blank

100 ml of 6N NaOH

Container 7
0.1N NaOH Blank

100 ml of 0.1N NaOH

Container 8
Acetone Blank

100 ml of acetone only if recovering Container 1

Field Train Blank

Sampling train was assembled, leak checked and recovered at sampling area, but no gaseous sample was collected

Field Spike Blank

2ml of Field Spike Standard into one impinger containing 100 ml NaOH. Follow standard impinger recovery procedures. Retain aliquot of Field Spike Standard for comparative analysis

Other Test Method 29
Analytical Flowchart

- Log each sample in shipment and verify against chain-of-custody sheet
- Note liquid levels in the sample containers and confirm on the chain-of-custody sheet condition

Containers 1 and 2 (Optional particulate analysis)

Follow analytical procedures outlined in EPA Method 5

Containers 3 and 4

Measure the sample volume. Sample dilution with 0.1N or 0.6N NaOH is recommended. The pH should not drop below 12 as a result of dilution

Analysis by ion chromatography for HCN

Each sample injected for analysis must have duplicate injection.

Perform a matrix spike at least once per set of sample or once per 10 samples analyzed. The amount of HCN recovered must be 20% of spiked value

If the response from cyanide in any sample is greater than the highest calibration standard, dilute with 0.1N or 0.6N NaOH and repeat analysis until response falls within calibration curve

Container 5 Silica Gel

Weigh to nearest 0.5 g. This can be done in the field

Reagent Blanks

Analyze by ion chromatography for HCN

Specification Sheet for EPA Method 25A

Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	Total Hydrocarbon (THC)
Other Parameters to be Determined from Train	O2 and CO2 (EPA Method 3A)

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	1
Sample Time per Point	N/A	60 minutes
Sampling Rate	Constant Rate	Constant Rate
Sampling Probe		
Nozzle Material	N/A	None
Nozzle Design	N/A	N/A
Probe Liner Material	Stainless Steel or Pyrex Glass	Stainless Steel
Effective Probe Length	Sufficient to Traverse Points	TBD
Probe Temperature Set-Point	Prevent Condensation	248°F±25°F
Particulate Filter		
In-Stack Filter	Yes	No
In-Stack Filter Material	Non-reactive to gas	N/A
External Filter	Yes	Yes
External Filter Material	Borosilicate, Quartz Glass Wool or Fiber Mat	Borosilicate Glass Fiber Mat
External Filter Set-Point	Prevent Condensation	248°F±25°F
Sample Delivery System		
Heated Sample Line Material	Stainless Steel or Teflon	Teflon
Heated Sample Line Set-Point	Prevent Condensation	248°F±25°F
Heated Sample Line Connections	Probe Exit to Moisture Removal System	Probe to Moisture Removal System
Moisture Removal System	Refrigerator-type condenser or similar	Refrigerator-type condenser
Sample Pump Type	Leak-Free, minimal response time	Diaphragm
Sample Pump Material	Non-reactive to sample gases	Teflon
Sample Flow Control	Constant Rate	Constant Rate (±10%)
Non-Heated Sample Line Material	Stainless Steel or Teflon	Teflon
Non-Heated Sample Line Connections	Moisture Removal to Sample Gas Manifold	Moisture Removal to Sample Gas Manifold
Additional Filters	Optional	Yes
Additional Filter Type	N/A	Particulate Removal
Additional Filter Location	Optional	Entrance to Sample Manifold
Filter Material	Non-reactive to sample gases	Glass Fiber
Analyzer Description		
Oxygen (O_2)	EPA Method 3A (Paramagnetic)	EPA Method 3A (Paramagnetic)
Carbon Dioxide (CO_2)	EPA Method 3A (NDIR)	EPA Method 3A (NDIR)
Sulfur Dioxide (SO_2)	EPA Method 6C (UV, NDIR or Fluorescence)	N/A
Nitrogen Oxides (NO_x)	EPA Method 7E (Chemiluminescent)	N/A
Carbon Monoxide (CO)	EPA Method 10 (Gas Filter Correlation IR)	N/A
Total Hydrocarbon (THC)	EPA Method 25A (Flame Ionization)	EPA Method 25A (Flame Ionization Detection)
Hydrogen Chloride (HCl)	N/A	N/A
Ammonia (NH_3)	N/A	N/A

Specification Sheet for EPA Method 25A

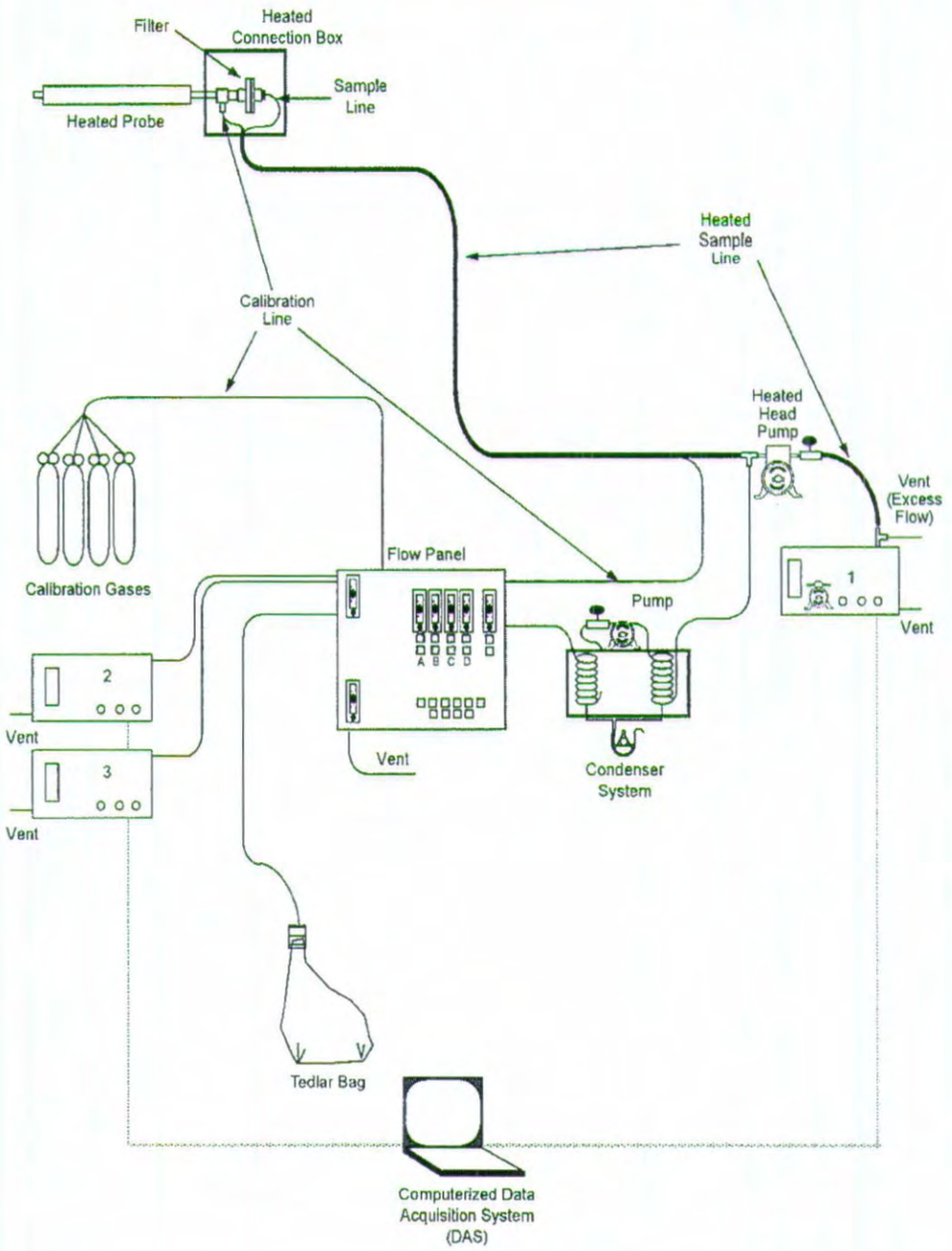
	Standard Method Specification	Actual Specification Used
Instrument Span Range		
Oxygen (O_2)	≤ 1.33 x Expected Maximum	0-25%
Carbon Dioxide (CO_2)	≤ 1.33 x Expected Maximum	0-25%
Sulfur Dioxide (SO_2)	≤ 1.33 x Expected Maximum	N/A
Nitrogen Oxides (NO_x)	≤ 1.33 x Expected Maximum	N/A
Carbon Monoxide (CO)	1000 ppm maximum	N/A
Total Hydrocarbon (THC)	1.5 to 2.5 x Expected Maximum	0-100 ppm
Hydrogen Chloride (HCl)	N/A	N/A
Ammonia (NH_3)	N/A	N/A
Data Acquisition		
Data Recorder	Strip chart, Analog Computer or Digital Recorder	Digital Recorder
Recorder Resolution	0.5 Percent of Span	0.1 Percent of Span
Data Storage	Manually or Automatic	Automatic
Measurement Freq. ≤60 min. Sample Time	1-min. intervals or 30 measurements (less restrictive)	One reading per second
Recording Freq. ≤60 min. Sample Time	1-min. intervals or 30 measurements (less restrictive)	One Minute Average (60, 1 second readings)
Measurement Freq. >60 min. Sample Time	2-min. intervals or 96 measurements (less restrictive)	N/A
Recording Freq. >60 min. Sample Time	2-min. intervals or 96 measurements (less restrictive)	N/A
Calibration Gas Specifications		
Oxygen (O_2)	EPA Protocol 1	EPA Protocol 1
Carbon Dioxide (CO_2)	EPA Protocol 1	EPA Protocol 1
Sulfur Dioxide (SO_2)	EPA Protocol 1	N/A
Nitrogen Oxides (NO_x)	EPA Protocol 1	N/A
Carbon Monoxide (CO)	EPA Protocol 1	N/A
Total Hydrocarbon (THC)	EPA Protocol 1	EPA Protocol 1
Hydrogen Chloride (HCl)	N/A	N/A
Ammonia (NH_3)	N/A	N/A

Specification Sheet for EPA Method 18

Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	Methane (CH_4) and Ethane (C_2H_6)
Other Parameters to be Determined from Train	None

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	60 minutes
No. of Sample Traverse Points	N/A	1
Sample Time per Point	N/A	60 minutes
Sampling Rate	Constant Rate (±10%)	Constant Rate (0.5 lpm±10%)
Sampling Probe		
Nozzle Material	N/A	None
Nozzle Design	N/A	N/A
Probe Liner Material	Teflon or Stainless Steel	None
Effective Probe Length	N/A	N/A
Probe Temperature Set-Point	Prevent condensation	None
Velocity Measuring Equipment		
Pitot Tube Design	None	None
Pitot Tube Coefficient	N/A	N/A
Pitot Tube Calibration by	N/A	N/A
Pitot Tube Attachment	N/A	N/A
Metering System Console		
Meter Type	Flow Meter, Critical Orifice or equivalent	Flow Meter
Meter Accuracy	±1%	±5%
Meter Resolution	N/A	0.01 liters
Meter Size	N/A	N/A
Meter Calibrated Against	Bubble Meter	N/A
Pump Type	Diaphragm or equivalent	Diaphragm
Temperature Measurements	Dial Thermometer or equivalent	N/A
Temperature Resolution	N/A	N/A
ΔP Differential Pressure Gauge	N/A	N/A
ΔH Differential Pressure Gauge	N/A	N/A
Barometer	Mercury, aneroid or other.	N/A
Filter Description		
Filter Location	N/A	None
Filter Holder Material	N/A	N/A
Filter Support Material	N/A	N/A
Cyclone Material	N/A	None
Filter Heater Set-Point	N/A	N/A
Filter Material	N/A	N/A
Sample Storage Components		
Description	Tedlar Bag or Stainless Steel Canister	Tedlar Bag
Location	After Pump and Flow Meter	After Pump and Flowmeter
Operating Temperature	N/A	Ambient

EPA Methods 3A / 18 / 25A
Sampling Train Configuration



Number	Gas	Monitor	Range Used	Calibration Gas Concentrations
1	THC	JUM 3-300	0-100 ppmdv	TBD
2	O2	Servomex 1420B	0-25%dv	TBD
3	CO2	Servomex 1415C	0-25%dv	TBD

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Servomex 1420C Oxygen Analyzer

The 1420C Includes:

- Analyzer
- Power cord
- Signal cable
- Manual
- Calibration sheet
- Instrument Rental Shipping Container

Specifications:

- Weight: 12 lbs.
- Dimensions: 9" x 5" x 7" (single unit)
- Range: 0-25 & 100% O2.
- Accuracy: +/- 0.1%
- Linearity: +/- 0.1% O2
- Repeatability: +/- 0.1% O2
- Response time (T90): 2.5 seconds at 200 ml/min; 2.0 seconds at 250 ml/min
- Zero Drift: <+/- .002% O2/hour
- Span Drift: <+/- .002% O2/hour
- Warm up time: typically 1 hour
- Electrical output: 0-1V non-isolated (min load 1K) or 4-20mA isolated (max load 600?).
- Display: 3.5 digit green LED display
- Display resolution: 0.1%
- AC Supply: 88-264VAC, 47-63 Hz
- Power required: 45 VA
- Operating ambient temperature: 32oF to 113oF (0oC to 45oC) as standard. 32oF to 104oF (0oC to
- 40oC) when fitted in bench top case.
- Storage temperature: -4oF to 158oF (-20oC to 70oC).
- Relative humidity: 0-90% non-condensing.

Rental/Application Notes:

- Effect of ambient temperature: <+/- 0.03% O2/C zero; <+/- 0.10% O2/C span
- Effect of barometric pressure: The analyzer measures the partial pressure of oxygen in the sample gas. Therefore, any change in sample pressure at the measuring cell will have an effect, which is proportional to the change in absolute pressure from time of calibration. An analyzer for oxygen purity (with pressure compensation) reduces error by a factor of approximately 5.
- Inlet pressure: 1-10 psig (7-70 kPag)
- Vent pressure: 11.6 to 15.9 psia (80-110 kPag)
- Flow rate: 1-6 lpm
- The Servomex 1420C/1415C can be plumbed together in a 19" rack mount (Model 1440C). The combined weight is 44 lbs. These units are compatible with the older 1400B series.
- When renting, equipment must be returned in its original packaging.

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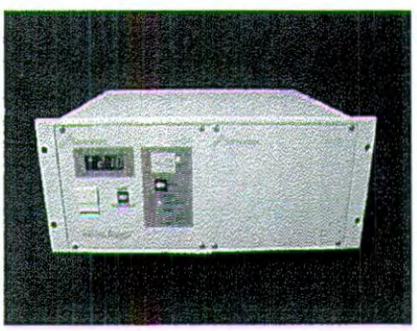
Servomex 1415C CO2 Analyzer



The 1415C Includes:

- Analyzer
- Power cord
- Signal cable
- Manual
- Calibration sheet
- Instrument Rental Shipping Container

Specifications:

- Weight: 12 lbs.
- Dimensions: 9" x 5" x 7" (single unit)
- Range: 0-20 & 25% CO_2.
- Accuracy: 1% of selected range
- Linearity: 1% of selected range
- Repeatability: 1% of selected range
- Response time (T90): <10 seconds
- Zero Drift: 2% of full scale/week
- Span Drift: 1% of reading/day
- Warm up time: typically 1 hour
- Electrical output: 0-1V non-isolated (min load 1K) or 4-20mA isolated (max load 600?).
- Display: 3.5 digit green LED display reading.
- Display resolution: 0.1%
- AC Supply: 88-264VAC, 47-63 Hz
- Power required: 45 VA
- Operating ambient temperature: 32°F to 113°F (0°C to 45°C) as standard. 32°F to 104°F (0°C to
- 40°C) when fitted in bench top case.
- Storage temperature: -4°F to 158°F (-20°C to 70°C)
- Relative humidity: 0-90% non-condensing.

Rental/Application Notes:

- Effect of ambient temperature: 1% of full scale per 10°C change.
- Effect of barometric pressure: 0.15% of reading per mbar within specified range.
- Inlet pressure: 1-10 psig (7-70 kPag)
- Vent pressure: 11.6 to 15.9 psia (80-110 kPag)
- Flow rate: 1-6 lpm
- The Servomex 1420C/1415C can be plumbed together in a 19" rack mount (Model 1440C). The combined weight is 44 lbs. These units are compatible with the older 1400B series.
- Equipment must be returned in its original packaging.

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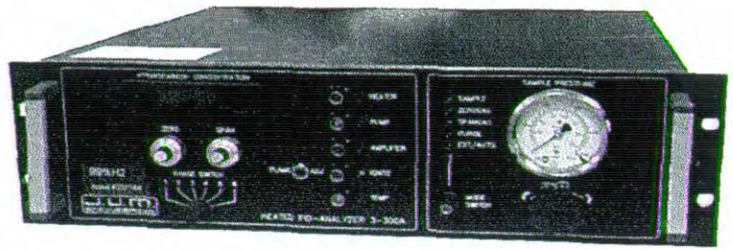
INSTRUMENT RENTAL

JUM 3-300 Total Hydrocarbon (THC) Analyzer



Rental/Application Notes:

- Designed for EPA Method 25A Testing
- Direct reading in parts per million (ppm) - sensitive down to one ppm (as Methane)
- Our in-house calibration is done using propane (C_3) balanced in nitrogen unless requested otherwise. Methane is available. Specify air or nitrogen background also & fuel type.
- Response factors can be generated for other compounds upon request. (Additional set-up fees will apply.)
- When renting, equipment must be returned in its original packaging.

Specifications:

Unit Weight	50 lbs.
Shipping Weight	60 lbs.
Number of Boxes	1
Dimensions	19" x 18.125" x 5.2"
Detection Method	Flame Ionization Detector (FID)
Detection Limit	1ppm CH_4 @ FS
Manufacturer's Ranges	0-10, 100, 1000, 10000, 100000ppm
CleanAir Suggested Ranges	
Operating Temperature	
Power	850 watts
Sample Flow Rate	2.5 LPM
Outputs	0-10V, 4-20mA
Drift	Span (24 hr): <1% FS Zero (24hr): <1% FS
Linearity	within 1% of FS
Response Time	0.2 sec.
Warm Up Time	

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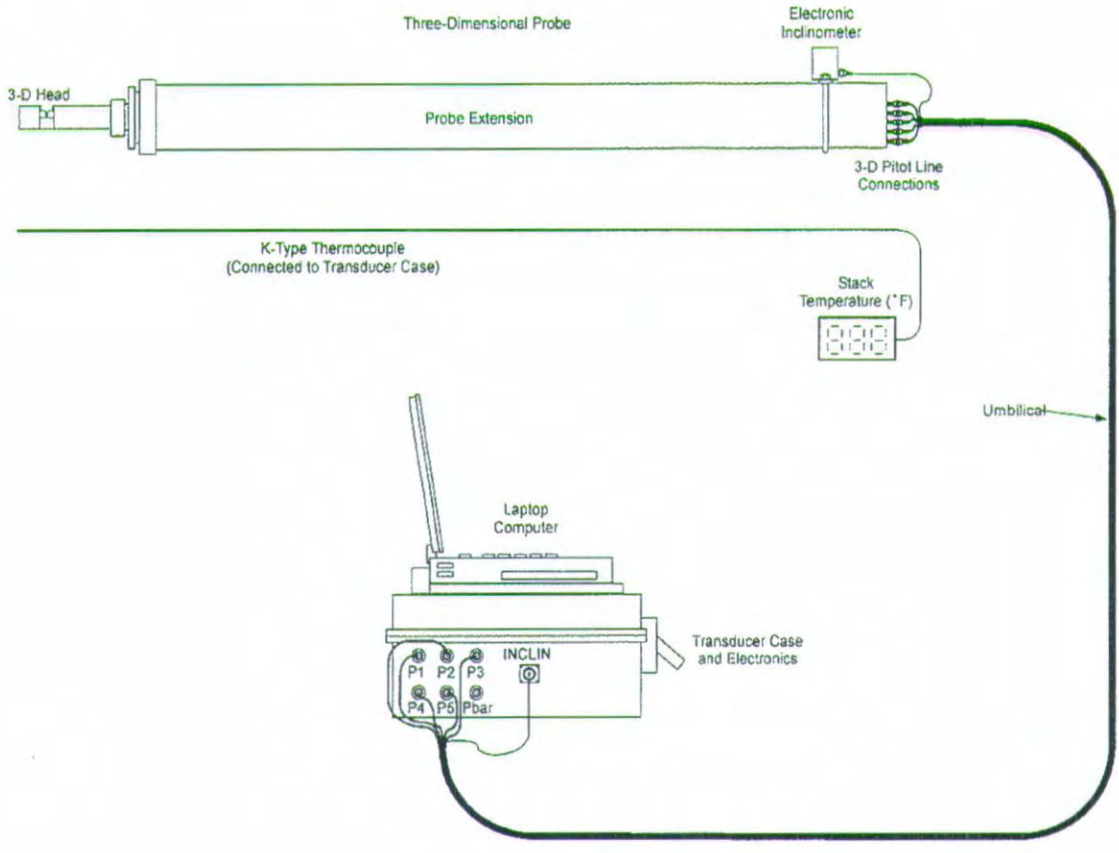
Specification Sheet for EPA Method 2F/2H

Source Location Name(s)	FCCU Regenerator Stack
Pollutant(s) to be Determined	None
Other Parameters to be Determined from Train	Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	Varied
No. of Sample Traverse Points	N/A	16/40
Sample Time per Point	N/A	Varied
Sampling Rate	N/A	N/A
Sampling Probe		
Nozzle Material	N/A	N/A
Nozzle Design	N/A	N/A
Probe Liner Material	N/A	N/A
Effective Probe Length	Sufficient to Traverse Points	TBD
Probe Temperature Set-Point	N/A	N/A
Velocity Measuring Equipment		
Pitot Tube Design	3-D Probe	3-D Probe
Pitot Tube Coefficient	See Data Sheets	See Data Sheets
Pitot Tube Calibration by	Geometric or Wind Tunnel	Wind-Tunnel
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	ASC 3DDAS
Meter Accuracy	N/A	N/A
Meter Resolution	N/A	N/A
Meter Size	N/A	N/A
Meter Calibrated Against	N/A	N/A
Pump Type	N/A	N/A
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Digital Manometer
ΔH Differential Pressure Gauge	N/A	N/A
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	N/A	N/A
Filter Holder Material	N/A	N/A
Filter Support Material	N/A	N/A
Cyclone Material	N/A	N/A
Filter Heater Set-Point	N/A	N/A
Filter Material	N/A	N/A
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

EPA Method 2F/2H
Sampling Train Configuration



SAMPLE CALCULATIONS

B

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified accurate.

QA/QC Initials: _____

Date: _____

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USEPA Methods 1-4
Sampling, Velocity and Moisture Sample Calculations

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Volume of water collected (wscf)

$$V_{wstd} = (0.04706)(V_{lc})$$

Where:

V_{lc}	= total volume of liquid collected in impingers and silica gel (ml)	=		ml
0.04706	= ideal gas conversion factor (ft^3 water vapor/ml or gm)	=	0.04706	ft^3/ml
V_{wstd}	= volume of water vapor collected at standard conditions (ft^3)	=		ft^3

2. Volume of gas metered, standard conditions (dscf)

$$V_{mstd} = \frac{(17.64)(V_m)\left(P_{bar} + \frac{\Delta H}{13.6}\right)(Y_d)}{(460 + T_m)}$$

Where:

P_{bar}	= barometric pressure (in. Hg)	=		in. Hg
T_m	= average dry gas meter temperature (°F)	=		°F
V_m	= volume of gas sample through the dry gas meter at meter conditions (dcf)	=		dcf
Y_d	= gas meter correction factor (dimensionless)	=		
ΔH	= average pressure drop across meter box orifice (in. H_2O)	=		in. H_2O
17.64	= standard temperature to pressure ratio (°R/in. Hg)	=	17.64	°R/in. Hg
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in.H_2O/in. Hg
460	= °F to °R conversion constant	=	460	
V_{mstd}	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=		dscf

3. Sample gas pressure (in. Hg)

$$P_s = P_{bar} + \left(\frac{P_g}{13.6}\right)$$

Where:

P_{bar}	= barometric pressure (in. Hg)	=		in. Hg
P_g	= sample gas static pressure (in. H_2O)	=		in. H_2O
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in. H_2O/in. Hg
P_s	= absolute sample gas pressure (in. Hg)	=		in. Hg

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4. Actual water vapor pressure at sample gas temperature less than 212°F (in. Hg)

$$P_v = \frac{e^{\left(18.3036 - \frac{3816.44}{\frac{5}{9}(T_s - 32) + 273.15 - 46.13}\right)}}{25.4}$$

Where:

T_s	= average sample gas temperature (°F)	=		°F
18.3036	= Antoine coefficient	=	18.3036	°K
3816.44	= Antoine coefficient	=	3816.44	°K
273.15	= temperature conversion factor	=	273.15	°K
46.13	= Antoine coefficient	=	46.13	°K
25.4	= conversion factor	=	25.4	mm Hg/in. Hg
5/9	= Fahrenheit to Celsius conversion factor	=	5/9	°C/°F
32	= temperature conversion (°F)	=	32	°F
P_v	= vapor pressure, actual (in. Hg)	=		in. Hg

5. Water vapor pressure at gas temperature greater than 212°F (In. Hg)

$$P_v = P_s$$

Where:

P_s	= absolute sample gas pressure (in. Hg)	=	0.00	in. Hg
P_v	= water vapor pressure, actual (in. Hg)	=	0.00	in. Hg

6. Moisture measured in sample (% by volume)

$$B_{wo} = \frac{V_{wstd}}{\left(V_{mstd} + V_{wstd}\right)}$$

Where:

V_{mstd}	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	dscf
V_{wstd}	= volume of water collected at standard conditions (scf)	=	scf
B_{wo}	= proportion of water measured in the gas stream by volume	=	
		=	%

7. Saturated moisture content (% by volume)

$$B_{ws} = \frac{P_v}{P_s}$$

Where:

P_s	= absolute sample gas pressure (in. Hg)	=	in. Hg
P_v	= water vapor pressure, actual (in. Hg)	=	in. Hg
B_{ws}	= proportion of water vapor in the gas stream by volume at saturated conditions	=	%

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8. Actual water vapor in gas (% by volume)

$$B_w = MINIMUM \quad [B_{wo}, B_{ws}]$$

Where:

B_{ws}	= proportion of water vapor in the gas stream by volume at saturated conditions	=		
B_{wo}	= proportion of water measured in the gas stream by volume	=		
B_w	= actual water vapor in gas	=		
		=		%

9. Nitrogen (plus carbon monoxide) in gas stream (% by volume, dry)

$$N_2 + CO = 100 - CO_2 - O_2$$

Where:

CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=		%
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
100	= conversion factor (%)	=	100	%
N_2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=		%

10. Molecular weight of dry gas stream (lb/lb·mole)

$$M_d = (M_{CO_2})\frac{(CO_2)}{(100)} + (M_{O_2})\frac{(O_2)}{(100)} + (M_{N_2+CO})\frac{(N_2+CO)}{(100)}$$

Where:

M_{CO2}	= molecular weight of carbon dioxide (lb/lb·mole)	=	44.00	lb/lb·mole
M_{O2}	= molecular weight of oxygen (lb/lb·mole)	=	32.00	lb/lb·mole
M_{N2+CO}	= molecular weight of nitrogen and carbon monoxide (lb/lb·mole)	=	28.00	lb/lb·mole
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=		%
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
N_2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=		%
100	= conversion factor (%)	=	100	%
M_d	= dry molecular weight of sample gas (lb/lb·mole)	=		lb/lb·mole

11. Molecular weight of sample gas (lb/lb·mole)

$$M_s = (M_d)(1 - B_w) + (M_{H_2O})(B_w)$$

Where:

B_w	= proportion of water vapor in the gas stream by volume	=		
M_d	= dry molecular weight of sample gas (lb/lb·mole)	=		lb/lb·mole
M_{H2O}	= molecular weight of water (lb/lb·mole)	=	18.00	lb/lb·mole
M_s	= molecular weight of sample gas, wet basis (lb/lb·mole)	=		lb/lb·mole

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12. Velocity of sample gas (ft/sec)

$$V_s = (K_p)(C_p)\left(\overline{\sqrt{\Delta P}}\right)\left(\sqrt{\frac{(\overline{T_s}+460)}{(M_s)(P_s)}}\right)$$

Where:

K_p	= velocity pressure constant	=	85.49	
C_p	= pitot tube coefficient	=		
M_s	= wet molecular weight of sample gas, wet basis (lb/lb·mole)	=		lb/lb·mole
P_s	= absolute sample gas pressure (in. Hg)	=		in. Hg
T_s	= average sample gas temperature (°F)	=		°F
$\sqrt{\Delta P}$	= average square roots of velocity heads of sample gas (in. H_2O)	=		$\sqrt{}$in. H_2O
460	= °F to °R conversion constant	=	460	
V_s	= sample gas velocity (ft/sec)	=		ft/sec

13. Volumetric flow rate of sample gas at actual gas conditions (acfm)

$$Q_a = (60)(A_s)(V_s)$$

Where:

A_s	= cross sectional area of sampling location (ft^2)	=		ft^2
V_s	= sample gas velocity (ft/sec)	=		ft/sec
60	conversion factor (sec/min)	=	60	sec/min
Q_a	= volumetric flow rate at actual conditions (acfm)	=		acfm

14. Total flow of sample gas (scfm)

$$Q_s = (Q_a)\left(\frac{P_s}{29.92}\right)\left(\frac{68+460}{T_s+460}\right)$$

Where:

Q_a	= volumetric flow rate at actual conditions (acfm)	=		acfm
P_s	= absolute sample gas pressure (in. Hg)	=		in. Hg
29.92	= standard pressure (in. Hg)	=	29.92	in. Hg
T_s	= average sample gas temperature (°F)	=		°F
68	= standard temperature (°F)	=	68	°F
460	= °F to °R conversion constant	=	460	
Q_s	= volumetric flow rate at standard conditions, wet basis (scfm)	=		scfm

15. Dry flow of sample gas (dscfm)

$$Q_{std} = (Q_s)(1 - B_w)$$

Where:

B_w	= proportion of water vapor in the gas stream by volume	=		
Q_s	= volumetric flow rate at standard conditions, wet basis (scfm)	=		scfm
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm

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16. Dry flow of sample gas corrected to 7%O_2 (dscfm)

$$Q_{std\,7} = (Q_{std})\left(\frac{20.9 - O_2}{20.9 - 7}\right)$$

Where:

Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
7	= oxygen content of corrected gas (%)	=	7.0	%
Q_{std7}	= volumetric flow rate at STP and 7%O_2, dry basis (dscfm)	=		dscfm

17. Hourly time basis conversion of volumetric flow rate (Q_{std} example)

$$Q_{std-hr} = (Q_{std-min})(60)$$

Where

$Q_{std-min}$	= volumetric flow rate, english units (ft^3/min)	=		dscfm
60	= conversion factor (min/hr)	=	60	min/hr
Q_{std-hr}	= volumetric flow rate, hourly basis (dscf/hr)	=		dscf/hr

18. Metric Conversion of Gas Volumes (Q_{std} example)

$$Q_{std-metric} = (Q_{std-english})\left(\frac{60}{35.31}\right)$$

Where:

$Q_{std-english}$	= volumetric flow rate, english units (ft^3/min)	=		dscfm
35.31	= conversion factor (ft^3/m^3)	=	35.31	ft^3/m^3
60	= conversion factor (min/hr)	=	60	min/hr
$Q_{std-metric}$	= volumetric flow rate, metric units (m^3/hr)	=		dry std m^3/hr

19. Standard to Normal Conversion of Gas Volumes (Q_{std} example)

$$Q_{Normal} = (Q_{std-metric})\left(\frac{32 + 460}{68 + 460}\right)$$

Where:

$Q_{std-metric}$	= volumetric flow rate, metric units (dry std m^3/hr)	=		dry std m^3/hr
32	= normal temperature (°F)	=	32	°F
68	standard temperature (°F)	=	68	°F
460	= standard temperature in Rankine (68°F)	=	460	
Q_{Normal}	= volumetric flow rate, metric units (dry Nm^3/hr)	=		dry Nm^3/hr

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20. Percent isokinetic (%)

$$I = \frac{(0.09450)(\overline{T_s} + 460)(V_{mstd})}{(P_s)(V_s)\left(\frac{(D_n)^2(\pi)}{(144)(4)}\right)(\Theta)(1 - B_w)}$$

Where:

D_n	= diameter of nozzle (in)	=		in.
B_w	= proportion of water vapor in the gas stream by volume	=		
P_s	= absolute sample gas pressure (in. Hg)	=		in. Hg
T_s	= average sample gas temperature (°F)	=		°F
V_{mstd}	= volume of gas sample through the dry gas meter at standard conditions (dscf)	=		dscf
V_s	= sample gas velocity (ft/sec)	=		ft/sec
θ	= total sampling time (min)	=		min
0.0945	= conversion constant	=	0.0945	
460	= °F to °R conversion constant	=	460	
I	= percent of isokinetic sampling (%)	=		%

21. Alternative Method 5 Post-Test Meter Calibration Factor

$$Y_{qa} = \frac{\Theta}{V_m}\sqrt{\frac{(0.0319)(T_m + 460)(28.96)}{(\Delta H_{@})(P_{bar} + \frac{\Delta H}{13.6})(M_d)}}(\sqrt{\Delta H})_{avg}$$

Where:

θ	= total sampling time (min)	=		min
V_m	= volume of gas sample through the dry gas meter at meter conditions (dcf)	=		dcf
T_m	= average dry gas meter temperature (°F)	=		°F
$\Delta H_{@}$	= dry gas meter orifice coefficient	=		
P_{bar}	= barometric pressure (in. Hg)	=		in. Hg
ΔH	= average pressure drop across meter box orifice (in. H_2O)	=		in. H_2O
M_d	= dry molecular weight of sample gas (lb/lb·mole)	=		lb/lb·mole
$\sqrt{\Delta H_{avg}}$	= average of square root of pressure drop across meter orifice	=		√in. H_2O
0.0319	= conversion constant	=	0.0319	
28.96	= molecular weight of ambient air (lb/lb-mole)	=	28.96	lb/lb-mole
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in.H_2O/in. Hg
460	= °F to °R conversion constant	=	460	
Y_{qa}	= alternative Method 5 post-test meter calibration factor	=		

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USEPA Method 5/202 (FPM/CPM)
Sample Laboratory Analysis Calculations for FPM

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1. Residue mass of filter used in calculation

$$m_{fi-calc} = m_{fi} \quad \text{if } m_{fi} \geq MDL_f$$

$$m_{fi-calc} = (MDL_f)(F_r) \quad \text{if } m_{fi} < MDL_f$$

Where:

m_{f1}	= reported mass of filter "1" from gravimetric analysis (g)	=		g
m_{f2}	= reported mass of filter "2" from gravimetric analysis (g)	=		g
m_{f3}	= reported mass of filter "3" from gravimetric analysis (g)	=		g
m_{f4}	= reported mass of filter "4" from gravimetric analysis (g)	=		g
MDL_f	= reported minimum gravimetric detection limit for filter fraction (g)	=		g
F_r	= fraction of MDL applied to non-detectable run sample (g)	=		
$m_{f1\text{-}calc}$	= residue mass of filter "1" used in calculation (g)	=		g
$m_{f2\text{-}calc}$	= residue mass of filter "2" used in calculation (g)	=		g
$m_{f3\text{-}calc}$	= residue mass of filter "3" used in calculation (g)	=		g
$m_{f4\text{-}calc}$	= residue mass of filter "4" used in calculation (g)	=		g

2. Total filter residue (g)

$$m_{filter} = \sum_{i=1}^{n} m_{fi-calc}$$

Where:

$m_{f1\text{-}calc}$	= residue mass of filter "1" used in calculation (g)	=		g
$m_{f2\text{-}calc}$	= residue mass of filter "2" used in calculation (g)	=		g
$m_{f3\text{-}calc}$	= residue mass of filter "3" used in calculation (g)	=		g
$m_{f4\text{-}calc}$	= residue mass of filter "4" used in calculation (g)	=		g
m_{filter}	= total particulate collected on filters (g)	=	0.00000	g

3. Aliquot residue mass of blank sample used in calculation (g)

$$r_{ai-blank-calc} = r_{ai-blank} \quad \text{if } r_{ai-blank} \geq MDL_s$$

$$r_{ai-blank-calc} = (MDL_s)(F_b) \quad \text{if } r_{ai-blank} < MDL_s$$

Where:

			Acetone	
$r_{ai\text{-}blank}$	= aliquot residue mass of blank sample for solvent "i" (g)	=		g
MDL_s	= reported minimum gravimetric detection limit for solvent rinse (g)	=		g
F_b	= fraction of MDL applied to non-detectable blank sample (g)	=		
$r_{ai\text{-}blank\text{-}calc}$	= aliquot residue mass of blank sample for solvent "i" used in calculation (g)	=		

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4. Aliquot residue mass of run sample used in calculation (g)

$$r_{ai-calc} = r_{ai} \quad \text{if } r_{ai} \geq MDL_s$$

$$r_{ai-calc} = (MDL_s)(F_r) \quad \text{if } r_{ai} < MDL_s$$

Where:			Acetone	
r_{ai}	= aliquot residue mass of run sample for solvent "i" (g)	=		g
MDL_s	= reported minimum gravimetric detection limit for solvent rinse (g)	=		g
F_r	= fraction of MDL applied to non-detectable run sample (g)	=	1.00	
$r_{ai-calc}$	= aliquot residue mass of run sample for solvent "i" used in calculation (g)	=		

5. Residue mass of run sample (g)

$$r_{si} = (r_{ai-calc})\left(\frac{v_{si}}{v_{ai}}\right)$$

Where:			Acetone	
$r_{ai-calc}$	= aliquot residue mass of run sample for solvent "i" used in calculation (g)	=		
v_{si}	= liquid volume of run sample for solvent rinse "i" (mL)	=		mL
v_{ai}	= aliquot volume use for solvent rinse "i" (mL) used in gravimetric analysis (mL)	=		mL
r_{si}	= residue mass of run sample for solvent rinse "i" (g)	=		

6. Maximum allowable blank correction for solvent rinse (g)

$$m_{bi} = MINIMUM\left[\left(\frac{(r_{ai-blank-calc})(v_{si})}{v_{ai-blank}}\right) \; or \; (0.00001)(\rho_i)(v_{si}) \; or \; (r_{si})\right]$$

Where:			Acetone	
$r_{ai-blank-calc}$	= blank aliquot residue mass for solvent "i" used in calculation (g)	=		
v_{si}	= liquid volume of run sample for solvent rinse "i" (mL)	=		mL
$v_{ai-blank}$	= liquid volume of blank sample for solvent rinse "i" (mL)	=		mL
0.00001	= EPA M-5 fraction of total rinse that can be subtracted (g)	=	0.00001	
ρ_i	= density of solvent rinse "i" (g/mL)	=	0.7845	g/ml
r_{si}	= residue mass of run sample for solvent rinse "i" (g)	=		
m_{bi}	= maximum allowable blank correction for solvent rinse "i" (g)	=		

7. Net residue mass of run sample (g)

$$m_i = (r_{si} - m_{bi})$$

Where:			Acetone	
r_{si}	= residue mass of run sample for solvent rinse "i" (g)	=		
m_{bi}	= maximum allowable blank correction for solvent rinse "i" (g)	=		
m_i	= net residue mass of run sample for solvent rinse "i" (g)	=		g

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8. Total solvent residue - (g)

$$m_s = \sum_{i=1}^{n} m_i$$

Where:

m_1	= net residue mass of solvent rinse "1" (g)	=	g
m_2	= net residue mass of solvent rinse "2" (g)	=	g
m_3	= net residue mass of solvent rinse "3" (g)	=	g
m_s	= total solvent residue (g)	=	g

9. Total gravimetric result (g)

$$m_T = m_{filter} + m_s$$

Where:

m_{filter}	= total particulate collected on filters (g)	=	g
m_s	= total solvent residue (g)	=	g
m_T	= total gravimetric result (g)	=	g

10. Total gravimetric detection limit (g)

$$m_D = (MDL_f)(n_f) + (MDL_s)(n_s)$$

Where:

MDL_f	= reported minimum gravimetric detection limit for filter fraction (g)	=	g
n_f	= number of filters in analysis	=	
MDL_s	= reported minimum gravimetric detection limit for solvent rinse (g)	=	g
n_s	= number of solvent rinses in analysis	=	
m_D	= total gravimetric detection limit (g)	=	g

11. Total filterable particulate matter (g)

$$m_n = MAXIMUM[m_T \quad or \quad m_D]$$

Where:

m_T	= total gravimetric result (g)	=	g
m_D	= total gravimetric detection limit (g)	=	g
m_n	= total filterable particulate matter (g)	=	g

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1. Aliquot residue mass of inorganic blank sample used in calculation (g)

$$r_{ai-blank-calc} = r_{ai-blank} \quad \text{if } r_{ai-blank} \geq MDL_i$$

$$r_{ai-blank-calc} = (MDL_i)(F_b) \quad \text{if } r_{ai-blank} < MDL_i$$

Where:

$r_{ai-blank}$	= aliquot residue mass of inorganic blank sample (g)	=		g
MDL_i	= reported minimum gravimetric detection limit for inorganic fraction (g)	=		g
F_b	= fraction of MDL applied to non-detectable blank samples (g)	=		
$r_{ai-blank-calc}$	= aliquot residue mass of inorganic blank sample used in calculation (g)	=		g

2. Aliquot residue mass of inorganic run sample used in calculation (g)

$$r_{ai-calc} = r_{ai} \quad \text{if } r_{ai} \geq MDL_i$$

$$r_{ai-calc} = (MDL_i)(F_r) \quad \text{if } r_{ai} < MDL_i$$

Where:

r_{ai}	= aliquot residue mass of inorganic run sample (g)	=		g
MDL_i	= reported minimum gravimetric detection limit for inorganic fraction (g)	=		g
F_r	= fraction of MDL applied to non-detectable run samples (g)	=	1.00	
$r_{ai-calc}$	= aliquot residue mass of inorganic run sample used in calculation (g)	=		g

3. Residue mass of inorganic run sample (g)

$$r_i = (r_{ai-calc})\left(\frac{v_{si}}{v_{ai}}\right)$$

Where:

$r_{ai-calc}$	= aliquot residue mass of inorganic run sample used in calculation (g)	=		g
v_{si}	= liquid volume of inorganic run sample (mL)	=		mL
v_{ai}	= aliquot volume of inorganic run sample used in gravimetric analysis (mL)	=		mL
r_i	= residue mass of inorganic run sample (g)	=		g

4. Mass of NH_3 added to form ammonium sulfate during titration of inorganic fraction (g)

$$m_c = (17.03)(N)(v_t)(0.001) \quad \text{if } pH < 7.00$$

$$m_c = 0 \quad \text{if } pH \geq 7.00$$

Where:

17.03	= conversion constant for NH_3 (equation 12.2.1 of EPA M-202)	=	17.03	
N	= normality of titrant (meq/mL)	=		mg/L
v_t	= volume of titrant added (mL)	=		mL
0.001	= conversion factor, (g/mg)	=	0.001	g/mg
pH	= pH of the inorganic fraction	=		
m_c	= mass of NH_3 added to form ammonium sulfate during titration of inorganic fraction (g)	=		g

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5. Aliquot residue mass of organic blank sample used in calculation (g)

$$r_{ao-blank-calc} = r_{ao-blank} \quad \text{if } r_{ao-blank} \geq MDL_o$$

$$r_{ao-blank-calc} = (MDL_o)(F_b) \quad \text{if } r_{ao-blank} < MDL_o$$

Where:

$r_{ao-blank}$	= aliquot residue mass of organic blank sample (g)	=		g
MDL_o	= reported minimum gravimetric detection limit for organic fraction (g)	=		g
F_b	= fraction of MDL applied to non-detectable blank samples (g)	=		
$r_{ao-blank-calc}$	= aliquot residue mass of organic blank sample used in calculation (g)	=		g

6. Aliquot residue mass of organic run sample used in calculation (g)

$$r_{ao-calc} = r_{ao} \quad \text{if } r_{ao} \geq MDL_o$$

$$r_{ao-calc} = (MDL_o)(F_r) \quad \text{if } r_{ao} < MDL_o$$

Where:

r_{ao}	= aliquot residue mass of organic run sample (g)	=		g
MDL_o	= reported minimum gravimetric detection limit for organic fraction (g)	=		g
F_r	= fraction of MDL applied to non-detectable run samples (g)	=	1.00	
$r_{ao-calc}$	= organic sample aliquot residue mass used in calculation (g)	=		g

7. Residue mass of organic sample (g)

$$r_o = (r_{ao-calc})\left(\frac{v_{so}}{v_{ao}}\right)$$

Where:

$r_{ao-calc}$	= aliquot residue mass of organic run sample used in calculation (g)	=		g
v_{so}	= liquid volume of organic run sample (mL)	=		mL
v_{ao}	= aliquot volume of organic run sample used in gravimetric analysis (mL)	=		mL
r_o	= residue mass of organic sample (g)	=		g

8. Maximum allowable inorganic blank correction (g)

$$m_{bi} = MINIMUM\left[\left(\frac{(r_{ai-blank-calc} - m_{c-blank})(v_{si})}{v_{ai-blank}}\right) \text{ or } (0.002)\left(\frac{(r_{ai-blank-calc} - m_{c-blank})}{(r_{ai-blank-calc} - m_{c-blank}) + r_{ao-blank-calc}}\right) \text{ or } (r_i - m_c)\right]$$

$$\text{if } (r_{ai-blank-calc} - m_{c-blank}) + r_{ao-blank-calc} > 0$$

$$m_{bi} = 0 \quad \text{if } (r_{ai-blank-calc} - m_{c-blank}) + r_{ao-blank-calc} \leq 0$$

Where:

$r_{ai-blank-calc}$	= aliquot residue mass of inorganic blank sample used in calculation (g)	=		g
$m_{c-blank}$	= mass of NH_3 added to form ammonium sulfate during titration of inorganic blank (g)	=		g
v_{si}	= liquid volume of inorganic run sample (mL)	=		mL
$v_{ai-blank}$	= aliquot volume of inorganic blank sample used in gravimetric analysis (mL)	=		mL
0.002	= maximum total blank correction (equation 12.2.2 of EPA M-202) (g)	=	0.002	g
$r_{ao-blank-calc}$	= aliquot residue mass of organic blank sample used in calculation (g)	=		g
r_i	= residue mass of inorganic run sample (g)	=		g
m_c	= mass of NH_3 added to form ammonium sulfate during titration of inorganic fraction (g)	=		g
m_{bi}	= maximum allowable inorganic blank correction (g)	=		g

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9. Net residue mass of inorganic run sample after NH_3 and blank correction (g)

$$m_{ri} = r_i - m_c - m_{bi}$$

Where:

r_i	= residue mass of inorganic run sample (g)	=	g
m_c	= mass of NH_3 added to form ammonium sulfate during titration of inorganic fraction (g)	=	g
m_{bi}	= maximum allowable inorganic blank correction (g)	=	g
m_{ri}	= net residue mass of inorganic run sample after NH_3 and blank correction (g)	=	g

10. Total inorganic condensable particulate matter (g)

$$m_{CPMi} = MAXIMUM\left[m_{ri} \quad or \quad MDL_i\right]$$

Where:

m_{ri}	= net inorganic residue mass of sample after NH_3 and blank correction (g)	=	g
MDL_i	= reported minimum gravimetric detection limit for inorganic fraction (g)	=	g
m_{CPMi}	= total inorganic condensable particulate matter (g)	=	g

11. Maximum allowable organic blank correction (g)

$$m_{bo} = MINIMUM\left[\left(\frac{(r_{ao-blank-calc})(v_{so})}{v_{ao-blank}}\right) \quad or \quad (0.002)\left(\frac{r_{ao-blank-calc}}{(r_{ai-blank-calc} - m_{c-blank}) + r_{ao-blank-calc}}\right) \quad or \quad (r_o)\right] \quad \text{if } (r_{ai-blank-calc} - m_{c-blank}) + r_{ao-blank-calc} > 0$$

$$m_{bo} = 0 \quad \text{if } (r_{ai-blank-calc} - m_{c-blank}) + r_{ao-blank-calc} \le 0$$

Where:

$r_{ao-blank-calc}$	= aliquot residue mass of organic blank sample used in calculation (g)	=		g
v_{so}	= liquid volume of organic run sample (mL)	=		mL
$v_{ao-blank}$	= aliquot volume of organic blank sample used in gravimetric analysis (mL)	=		mL
0.002	= maximum total blank correction (equation 12.2.2 of EPA M-202) (g)	=	0.002	g
$r_{ai-blank-calc}$	= aliquot residue mass of inorganic blank sample used in calculation (g)	=		g
$m_{c-blank}$	= mass of NH_3 added to form ammonium sulfate during titration of inorganic blank (g)	=		g
r_o	= residue mass of organic run sample (g)	=		g
m_{bo}	= maximum allowable organic blank correction (g)	=		g

12. Net organic residue mass of sample after blank correction (g)

$$m_{ro} = r_o - m_{bo}$$

Where:

r_o	= residue mass of organic run sample (g)	=	g
m_{bo}	= maximum allowable organic blank correction (g)	=	g
m_{ro}	= net organic residue mass of sample after blank correction (g)	=	g

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13. Total organic condensable particulate matter (g)

$$m_{CPMo} = MAXIMUM\left[m_{ro} \quad or \quad MDL_o\right]$$

Where:

m_{ro}	= net organic residue mass of sample after blank correction (g)	=	g
MDL_o	= reported minimum gravimetric detection limit for organic fraction (g)	=	g
m_{CPMo}	= total organic condensable particulate matter (g)	=	g

14. Total gravimetric result (g)

$$m_T = m_{CPMi} + m_{CPMo}$$

Where:

m_{CPMi}	= total inorganic condensable particulate matter (g)	=	g
m_{CPMo}	= total organic condensable particulate matter (g)	=	g
m_T	= total gravimetric result (g)	=	g

15. Minimum detection limit for combined fractions (g)

$$MDL_c = MDL_i + MDL_o$$

Where:

MDL_i	= reported minimum gravimetric detection limit for inorganic fraction (g)	=	g
MDL_o	= reported minimum gravimetric detection limit for organic fraction (g)	=	g
MDL_c	= minimum detection limit for combined fractions (g)	=	g

16. Total condensable particulate matter (g)

$$m_{CPM} = MAXIMUM\left[m_T \quad or \quad MDL_c\right]$$

Where:

m_T	= total gravimetric result (g)	=	g
MDL_c	= minimum detection limit for combined fractions (g)	=	g
m_{CPM}	= total condensable particulate matter (g)	=	g

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1. Filterable particulate matter concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(2.205\times10^{-3}\right)$$

Where:

m_n	= total filterable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=	74.3801	dscf
2.205 x 10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
C_{sd}	= filterable particulate matter concentration (lb/dscf)	=		lb/dscf

2. Filterable particulate matter concentration (gr/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(15.43\right)$$

Where:

m_n	= total filterable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=	74.3801	dscf
15.43	= conversion factor (gr/g)	=	15.43	gr/g
C_{sd}	= filterable particulate matter concentration (gr/dscf)	=		gr/dscf

3. Filterable particulate matter concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(1000\right)\left(35.31\right)$$

Where:

m_n	= total filterable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=	74.3801	dscf
1000	= conversion factor (mg/g)	=	1,000	mg/g
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
C_{sd}	= filterable particulate matter concentration (mg/dscm)	=		mg/dscm

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4. Filterable particulate matter concentration (mg/Nm3 dry)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)(1000)(35.31)\left(\frac{68+460}{32+460}\right)$$

Where:

m_n	= total filterable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=	74.3801	dscf
1000	= conversion factor (mg/g)	=	1,000	mg/g
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
68	= standard temperature (°F)	=	68	°F
32	= normal temperature (°F)	=	32	°F
460	= °F to °R conversion constant	=	460	
C_{sd}	= filterable particulate matter concentration (mg/Nm3 dry)	=		mg/Nm^3 dry

5. Filterable particulate matter concentration corrected to x% O2 (gr/dscf example)

$$C_{sdx} = C_{sd}\left(\frac{20.9 - x}{20.9 - O_2}\right)$$

Where:

C_{sd}	= filterable particulate matter concentration (gr/dscf)	=		gr/dscf
x	= oxygen content of corrected gas (%)	=		%
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
C_{sdx}	= filterable particulate matter concentration corrected to x%O2 (gr/dscf)	=		gr/dscf @ x%O_2

6. Filterable particulate matter concentration at actual gas conditions (gr/acf example)

$$C_a = C_{sd}\left(\frac{Q_{std}}{Q_a}\right)$$

Where:

C_{sd}	= filterable particulate matter concentration (gr/dscf)	=		gr/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
Q_a	= volumetric flow rate at actual conditions (acfm)	=		acfm
C_a	= filterable particulate matter concentration at actual gas conditions (gr/acf)	=		gr/acf

7. Filterable particulate matter rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_n}{V_{mstd}}\right)(2.205\times10^{-3})(Q_{std})(60)$$

Where:

m_n	= total filterable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205 x 10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= filterable particulate matter rate (lb/hr)	=		lb/hr

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8. Filterable particulate matter rate - Fd-based (lb/MMBtu)

$$E_{Fd} = \left(\frac{m_n}{V_{mstd}}\right)\left(2.205\times10^{-3}\right)\left(F_d\right)\left(\frac{20.9}{20.9-O_2}\right)$$

Where:

m_n	= total filterable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205 x 10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
F_d	= ratio of gas volume to heat content of fuel (dscf/MMBtu)	=		dscf/MMBtu
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
E_{Fd}	= filterable particulate matter rate - Fd-based (lb/MMBtu)	=		lb/MMBtu

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USEPA Method 5/202 (FPM/CPM)
Sample Emission Calculations for CPM

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Condensable particulate matter concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_{CPM}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=	74.3801	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
C_{sd}	= condensable particulate matter concentration (lb/dscf)	=		lb/dscf

2. Condensable particulate matter matter concentration (gr/dscf)

$$C_{sd} = \left(\frac{m_{CPM}}{V_{mstd}}\right)\left(15.43\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=	74.3801	dscf
15.43	= conversion factor (gr/g)	=	15.43	gr/g
C_{sd}	= condensable particulate matter concentration (gr/dscf)	=		gr/dscf

3. Condensable particulate matter concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_{CPM}}{V_{mstd}}\right)\left(1000\right)\left(35.31\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=	74.3801	dscf
1000	= conversion factor (mg/g)	=	1,000	mg/g
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
C_{sd}	= condensable particulate matter concentration (mg/dscm)	=		mg/dscm

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4. Condensable particulate matter concentration (mg/Nm3 dry)

$$C_{sd} = \left(\frac{m_{CPM}}{V_{mstd}}\right)(1000)(35.31)\left(\frac{68+460}{32+460}\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=	74.3801	dscf
1000	= conversion factor (mg/g)	=	1,000	mg/g
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
68	= standard temperature (°F)	=	68	°F
32	= normal temperature (°F)	=	32	°F
460	= °F to °R conversion constant	=	460	
C_{sd}	= condensable particulate matter concentration (mg/Nm3 dry)	=		mg/Nm^3 dry

5. Condensable particulate matter concentration corrected to x% O2 (gr/dscf example)

$$C_{sdx} = C_{sd}\left(\frac{20.9-x}{20.9-O_2}\right)$$

Where:

C_{sd}	= condensable particulate matter concentration (gr/dscf)	=		gr/dscf
x	= oxygen content of corrected gas (%)	=		%
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
C_{sdx}	= condensable particulate matter concentration corrected to x% O2 (gr/dscf)	=		gr/dscf @ x%O_2

6. Condensable particulate matter concentration at actual gas conditions (gr/acf example)

$$C_a = C_{sd}\left(\frac{Q_{std}}{Q_a}\right)$$

Where:

C_{sd}	= condensable particulate matter concentration (gr/dscf)	=		gr/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
Q_a	= volumetric flow rate at actual conditions (acfm)	=		acfm
C_a	= condensable particulate matter concentration at actual gas conditions (gr/acf)	=		gr/acf

7. Condensable particulate matter rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_{CPM}}{V_{mstd}}\right)(2.205\times10^{-3})(Q_{std})(60)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205 x 10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= condensable particulate matter rate (lb/hr)	=		lb/hr

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8. Condensable particulate matter rate - Fd-based (lb/MMBtu)

$$E_{Fd} = \left(\frac{m_{CPM}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)\left(F_d\right)\left(\frac{20.9}{20.9 - O_2}\right)$$

Where:

m_{CPM}	= total condensable particulate matter (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
F_d	= ratio of gas volume to heat content of fuel (dscf/MMBtu)	=		dscf/MMBtu
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
E_{Fd}	= condensable particulate matter rate - Fd-based (lb/MMBtu)	=		lb/MMBtu

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USEPA Method 5/202 (FPM/CPM)
Sample Emission Calculations for Total Particulate (as PM10)

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Total particulate (expressed as PM-10)

$$m_{Part} = m_n + m_{CPM}$$

Where:

m_n	= total filterable particulate matter from 5 (g)	=		
m_{CPM}	= total condensable particulate matter from 202 (g)	=		
m_{Part}	= total particulate (expressed as PM-10) (g)	=		

2. Total particulate (expressed as PM-10) concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_{Part}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)$$

Where:

m_{Part}	= total particulate (expressed as PM-10) (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
C_{sd}	= total particulate (expressed as PM-10) concentration (lb/dscf)	=		lb/dscf

3. Total particulate (expressed as PM-10) concentration (gr/dscf)

$$C_{sd} = \left(\frac{m_{Part}}{V_{mstd}}\right)\left(15.43\right)$$

Where:

m_{Part}	= total particulate (expressed as PM-10) (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=		dscf
15.43	= conversion factor (gr/g)	=	15.43	gr/g
C_{sd}	= total particulate (expressed as PM-10) concentration (gr/dscf)	=		gr/dscf

4. Total particulate (expressed as PM-10) concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_{Part}}{V_{mstd}}\right)\left(1000\right)\left(35.31\right)$$

Where:

m_{Part}	= total particulate (expressed as PM-10) (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=		dscf
1000	= conversion factor (mg/g)	=	1000	mg/g
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
C_{sd}	= total particulate (expressed as PM-10) concentration (mg/dscm)	=		mg/dscm

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5. Total particulate (expressed as PM-10) concentration (mg/Nm3 dry)

$$C_{sd} = \left(\frac{m_{Part}}{V_{mstd}}\right)(1000)(35.31)\left(\frac{68+460}{32+460}\right)$$

Where:

m_{Part}	= total particulate (expressed as PM-10) (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=		dscf
1000	= conversion factor (mg/g)	=	1000	mg/g
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
68	= standard temperature (°F)	=	68	°F
32	= normal temperature (°F)	=	32	°F
460	= °F to °R conversion constant	=	460	
C_{sd}	= total particulate (expressed as PM-10) concentration (mg/Nm3 dry)	=		mg/Nm³ dry

6. Total particulate (expressed as PM-10) concentration corrected to x% O2 (gr/dscf example)

$$C_{sdx} = C_{sd}\left(\frac{20.9-x}{20.9-O_2}\right)$$

Where:

C_{sd}	= particulate concentration (gr/dscf)	=		gr/dscf
x	= oxygen content of corrected gas (%)	=		%
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
C_{sdx}	= total particulate (expressed as PM-10) concentration corrected to x% O2 (gr/	=		gr/dscf @ x%O_2

7. Total particulate (expressed as PM-10) concentration at actual gas conditions (gr/acf example)

$$C_a = C_{sd}\left(\frac{Q_{std}}{Q_a}\right)$$

Where:

C_{sd}	= particulate concentration (gr/dscf)	=		gr/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
Q_a	= volumetric flow rate at actual conditions (acfm)	=		acfm
C_a	= total particulate (expressed as PM-10) concentration at actual gas conditions	=		gr/acf

8. Total particulate (expressed as PM-10) rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_{Part}}{V_{mstd}}\right)(2.205\times10^{-3})(Q_{std})(60)$$

Where:

m_{Part}	= total particulate (expressed as PM-10) (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= total particulate (expressed as PM-10) rate (lb/hr)	=		lb/hr

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9. Total particulate (expressed as PM-10) rate - Fd-based (lb/MMBtu)

$$E_{Fd} = \left(\frac{m_{Part}}{V_{mstd}}\right)\left(2.205 \times 10^{-3}\right)\left(F_d\right)\left(\frac{20.9}{20.9 - O_2}\right)$$

Where:

m_{Part}	= total particulate (expressed as PM-10) (g)	=		g
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
F_d	= ratio of gas volume to heat content of fuel (dscf/MMBtu)	=		dscf/MMBtu
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
E_{Fd}	= total particulate (expressed as PM-10) rate - Fd-based (lb/MMBtu)	=		lb/MMBtu

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USEPA OTM-29
HCN Sample Calculations

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. HCN concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{2.205\times10^{-3}}{10^6}\right)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (µg)	=		µg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
10^6	= conversion factor (µg/g)	=	10^6	µg/g
C_{sd}	= HCN concentration (lb/dscf)	=		lb/dscf

2. HCN concentration (ppmdv)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{0.850}{10^6}\right)\left(\frac{10^6}{MW}\right)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (µg)	=		µg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
MW	= molecular weight of HCN (g/g-mole)	=	27.026	g/g-mole
0.850	= conversion factor (dscf/g-mole)	=	0.850	dscf/g-mole
10^6	= conversion factor (µg/g)	=	10^6	µg/g
10^6	= conversion factor (ppm)	=	10^6	ppm
C_{sd}	= HCN concentration (ppmdv)	=		ppmdv

3. HCN concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{35.31}{1000}\right)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (µg)	=		µg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
1000	= conversion factor (µg/mg)	=	1000	µg/mg
C_{sd}	= HCN concentration (mg/dscm)	=		mg/dscm

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4. HCN rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{2.205\times10^{-3}}{10^6}\right)(Q_{std})(60)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (µg)	=		µg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
10^6	= conversion factor (µg/g)	=	10^6	µg/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= HCN rate (lb/hr)	=		lb/hr

5. HCN rate (Ton/yr)

$$E_{T/yr} = \left(\frac{m_n}{V_{mstd}}\right)(2.205\times10^{-3})(Q_{std})(60)\left(\frac{Cap}{2000}\right)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (µg)	=		µg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
10^6	= conversion factor (µg/g)	=	10^6	µg/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
60	= conversion factor (min/hr)	=	60	min/hr
Cap	= capacity factor for process (hours operated/year)	=		hours/yr
2000	= conversion factor (lb/Ton)	=	2000	lb/Ton
$E_{T/yr}$	= HCN rate (Ton/yr)	=		Ton/yr

6. HCN rate - Production-based (lb/Mlb coke)

$$E_{RP} = \left(\frac{m_n}{V_{mstd}}\right)(2.205\times10^{-3})\left(\frac{Q_{std}\times60}{10^6\times R_p}\right)$$

Where:

m_n	= total HCN collected, corrected for applicable blank (µg)	=		µg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=		lb/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	61,642	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
10^6	= conversion factor (µg/g)	=	10^6	µg/g
R_p	= production rate (Mlb coke/hr)	=	19.066	Mlb coke/hr
E_{RP}	= HCN rate - production based(lb/Mlb coke)	=	1.7420E-01	lb/Mlb coke

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USEPA OTM-29
HCN Analyte Calculations

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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K

1. Cyanide to HCN conversion factor

$$K_a = \frac{MW_a}{n \times MW_{ion}}$$

Where:

MW_a	= molecular weight of HCN (mg/mg-mole)	=	27.026	mg/mg-mole
MW_{ion}	= molecular weight of Cyanide ion (mg/mg-mole)	=	27.026	mg/mg-mole
n	= molar ratio of Cyanide to HCN	=	1.0	mole HCN/mole HCN
K_a	= conversion factor to convert mass HCN to mass HCN	=	1.000	

2. Total HCN collected (µg)

$$m_a = K_a \times \left(S_{i-1} DF_1 v_1 + S_{i-2} DF_2 v_2\right)$$

Note: CN- to HCN conversion was made by analytical laboratory when reporting results.

Where:

K_a	= conversion factor to convert mass HCN to mass HCN	=	1.000	
S_{i-1}	= Cyanide concentration of sample fraction 1 (µg/mL)	=		µg/mL
DF_1	= dilution factor for sample fraction 1 (dimensionless)	=		
v_1	= liquid volume of sample fraction 1 (mL)	=		mL
S_{i-2}	= Cyanide concentration of sample fraction 2 (µg/mL)	=		µg/mL
DF_2	= dilution factor for sample fraction 2 (dimensionless)			
v_2	= liquid volume of sample fraction 2 (mL)	=		mL
m_a	= *total HCN collected in sample (µg)*	=		µg

DEFINITION
Fraction 1 = entire sample except last impinger containing applicable absorbing reagent.
Fraction 2 = last impinger containing applicable absorbing reagent, analyzed separately to evaluate collection efficiency.
If entire sample is analyzed as a single fraction, then data is included as Fraction 1 (Fraction 2 = 0).

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3. Allowable blank subtraction (µg)

$$m_b = K_a \times B_i \times (v_1 + v_2)$$

$$m_b = 0 \quad \text{if } B_i < MDL$$

Note: CN- to HCN conversion was made by analytical laboratory when reporting results.

Where:

K_a	= conversion factor to convert mass HCN to mass HCN	=	1.000	
B_F	= Cyanide concentration of blank (µg/mL)	=		µg/mL
v_1	= liquid volume of sample fraction 1 (mL)	=		mL
v_2	= liquid volume of sample fraction 2 (mL)	=		mL
m_b	= allowable blank subtraction (µg)	=		µg

4. Total HCN collected, corrected for blank (µg)

$$m_{nb} = m_a - m_b$$

Where:

m_a	= total HCN collected in sample (µg)	=		µg
m_b	= allowable blank subtraction (µg)	=		µg
m_{nb}	= total HCN collected, corrected for blank (µg)	=		µg

5. Minimum detectable HCN (µg)

$$m_{MDL} = K_a \times MDL \times (v_1 + v_2)$$

Note: CN- to HCN conversion was made by analytical laboratory when reporting results.

Where:

K_a	= conversion factor to convert mass HCN to mass HCN	=	1.000	
MDL	= minimum detectable Cyanide concentration (µg/mL)	=		µg/mL
v_1	= liquid volume of sample fraction 1 (mL)	=		mL
v_2	= liquid volume of sample fraction 2 (mL)	=		mL
m_{MDL}	= minimum detectable HCN (µg)	=		µg

6. Total HCN value used in emission calculations (µg)

$$m_n = MAXIMUM \left[m_{nb} \quad or \quad < m_{MDL} \right]$$

Where:

m_{nb}	= total HCN collected, corrected for blank (µg)	=		µg
m_{MDL}	= minimum detectable HCN (µg)	=		µg
m_n	= total HCN value used in emission calculations (µg)	=		µg

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7. Collection QC check (% mass collected in second fraction)

$$EFF = 100 \times \frac{K_a \times S_{i-2} \times DF_2 \times v_2}{m_a}$$

Note: CN- to HCN conversion was made by analytical laboratory when reporting results.

Where:

K_a	= conversion factor to convert mass HCN to mass HCN	=	1	
S_{i-2}	= Cyanide concentration of sample fraction 2 (µg/mL)	=		µg/mL
DF_2	= dilution factor for sample fraction 2 (dimensionless)			
v_2	= liquid volume of sample fraction 2 (mL)	=		mL
m_a	= total HCN collected in sample (µg)	=		µg
100	= conversion factor	=	100	%
EFF	= Collection QC check (% mass collected in second fraction)	=		%

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ASTM Draft Controlled Condensation Method
Sample Laboratory Analysis Calculations for H2SO4

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Sulfate to H2SO4 conversion factor

$$K_a = \frac{MW_a}{n \times MW_{ion}}$$

Where:

MW_a	= molecular weight of H2SO4 (mg/mg-mole)	=	98.079	mg/mg-mole
MW_{ion}	= molecular weight of Sulfate ion (mg/mg-mole)	=	96.057	mg/mg-mole
n	= molar ratio of Sulfate to H2SO4	=	1.0	mole SO4--/mole H2
K_a	= conversion factor to convert mass SO4-- to mass H2SO4	=	1.021	

2. Total H2SO4 collected (mg)

$$m_a = K_a \times \frac{(S_{i-1} v_1)}{1000}$$

Where:

K_a	= conversion factor to convert mass SO4-- to mass H2SO4	=	1.021	
S_{i-1}	= Sulfate concentration of sample fraction 1 (mg/liter)	=		mg/liter
v_1	= liquid volume of sample fraction 1 (ml)	=		ml
1000	= conversion factor (ml/liter)	=		ml/liter
m_a	= total H2SO4 collected in sample (mg)	=		mg

Note: Non-detects are treated as zero in summations.

3. Allowable blank subtraction (mg)

$$m_b = K_a \times B_i \times \frac{(v_1)}{1000}$$

$$m_b = 0 \quad \text{if } B_i < MDL$$

Where:

K_a	= conversion factor to convert mass SO4-- to mass H2SO4	=	1.021	
B_F	= Sulfate concentration of blank (mg/liter)	=		mg/liter
v_1	= liquid volume of sample fraction 1 (ml)	=		ml
1000	= conversion factor (ml/liter)	=	1000	ml/liter
m_b	= allowable blank subtraction (mg)	=		mg

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4. Total H2SO4 collected, corrected for blank (mg)

$$m_{nb} = m_a - m_b$$

Where:

m_a	= total H2SO4 collected in sample (mg)	=		mg
m_b	= allowable blank subtraction (mg)	=		mg
m_{nb}	= total H2SO4 collected, corrected for blank (mg)	=		mg

5. Minimum detectable H2SO4 (mg)

$$m_{MDL} = K_a \times MDL \times \frac{(v_{12})}{1000}$$

Where:

K_a	= conversion factor to convert mass SO4-- to mass H2SO4	=	1.021	
MDL	= minimum detectable Sulfate concentration	=		mg/liter
v_1	= liquid volume of sample fraction 1 (ml)	=		ml
1000	= conversion factor (ml/liter)	=	1000	ml/liter
m_{MDL}	= minimum detectable H2SO4 (mg)	=		mg

6. Total H2SO4 value used in emission calculations (mg)

$$m_n = MAXIMUM \left[m_{nb} \quad or \quad < m_{MDL} \right]$$

Where:

m_{nb}	= total H2SO4 collected, corrected for blank (mg)	=		mg
m_{MDL}	= minimum detectable H2SO4 (mg)	=		mg
m_n	= total H2SO4 value used in emission calculations (mg)	=		mg

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ASTM Draft Controlled Condensation Method
Sample Emission Calculations for H2SO4

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

122211 134313
N_@

1. H2SO4 concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{2.205 \times 10^{-3}}{1000}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=		mg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
C_{sd}	= H2SO4 concentration (lb/dscf)	=		lb/dscf

2. H2SO4 concentration (ppmdv)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{0.850}{1000}\right)\left(\frac{10^6}{MW}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=		mg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
MW	= molecular weight of H2SO4 (g/g-mole)	=	98.079	g/g-mole
0.850	= conversion factor (dscf/g-mole)	=	0.850	dscf/g-mole
1000	= conversion factor (mg/g)	=	1,000	mg/g
10^6	= conversion factor (ppm)	=	10^6	ppm
C_{sd}	= H2SO4 concentration (ppmdv)	=		ppmdv

3. H2SO4 concentration (ppmwv)

$$C_w = C_{sd}\left(1 - \frac{B_w}{100}\right)$$

Where:

C_{sd}	= H2SO4 concentration (ppmdv)	=		ppmdv
B_w	= actual water vapor in gas (% v/v)	=		% v/v
100	= conversion factor (%)	=	100	%
C_w	= H2SO4 concentration (ppmwv)	=		ppmwv

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4. H2SO4 concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)(35.31)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=		mg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
C_{sd}	= H2SO4 concentration (mg/dscm)	=		mg/dscm

5. H2SO4 concentration (mg/Nm3 dry)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)(35.31)\left(\frac{68 + 460}{32 + 460}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=		mg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
68	= standard temperature (°F)	=	68	°F
32	= normal temperature (°F)	=	32	°F
460	= °F to °R conversion constant	=	460	
C_{sd}	= H2SO4 concentration (mg/Nm3 dry)	=		mg/Nm^3 dry

6. H2SO4 concentration corrected to x% O2 (ppmdv example)

$$C_{sdx} = C_{sd}\left(\frac{20.9 - x}{20.9 - O_2}\right)$$

Where:

C_{sd}	= H2SO4 concentration (ppmdv)	=		ppmdv
x	= oxygen content of corrected gas (%)	=		%
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
C_{sdx}	= H2SO4 concentration corrected to x% O2 (ppmdv)	=		ppmdv @ x%O_2

7. H2SO4 concentration at actual gas conditions (lb/acf example)

$$C_a = C_{sd}\left(\frac{Q_{std}}{Q_a}\right)$$

Where:

C_{sd}	= H2SO4 concentration (lb/dscf)	=		lb/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
Q_a	= volumetric flow rate at actual conditions (acfm)	=		acfm
C_a	= H2SO4 concentration at actual gas conditions (lb/acf)	=		lb/acf

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8. H2SO4 rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{2.205 \times 10^{-3}}{1000}\right)(Q_{std})(60)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=		mg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= H2SO4 rate (lb/hr)	=		lb/hr

9. H2SO4 rate - Fd-based (lb/MMBtu)

$$E_{Fd} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{2.205 \times 10^{-3}}{1000}\right)(F_d)\left(\frac{20.9}{20.9 - O_2}\right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=		mg
V_{mstd}	= volume metered, standard (dscf)	=		dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
F_d	= ratio of gas volume to heat content of fuel (dscf/MMBtu)	=		dscf/MMBtu
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
E_{Fd}	= H2SO4 rate (lb/MMBtu)	=		lb/MMBtu

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USEPA Method 25A
Sample Field Calculations for THC

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

021414 141050

1. Average of a calibration series

$$C_{mce} = \frac{(C_1 + C_2 + C_3)}{3}$$

Where:

C_1, C_2, C_3 = concentrations of 3 consecutive gas samples that are representative of the calibration gas

C_{mce} = average concentration of a calibration series = ppmwv
In this case the low cal series for channel 2

2. Calibration Error Check for Hydrocarbons (5% of actual calibration gas value error allowed by Method 25A)

$$E_{HC} = abs\left|\frac{C_{mce} - C_{ma}}{C_{ma}}\right| \le l_{cal}$$

Where:

C_{mce} = average concentration of a calibration series = ppmwv
In this case the low cal series for channel 2

C_{ma} = concentration of actual calibration gas value = ppmwv

l_{cal} = limit for calibration error for hydrocarbons = 5.0%

E_{HC} = calibration error check value =

3. System Bias as Percent of Span Value (5% is allowed)

$$E_{Bias} = abs\left|\frac{C_{mf} - C_{mce}}{Span}\right| \le l_{bias}$$

Where:

C_{mce} = average concentration of a calibration series = ppmwv
#N/A

C_{mf} = calibration error response concentration for Cal01 = ppmwv

Span = instrument span value = ppmwv

l_{bias} = limit for system bias error = 5.0%

E_{bias} = calibration bias error check value =

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4. System Drift as Percent of Span Value (3%)

$$E_{Drift} = abs\left|\frac{C_{mf} - C_{mi}}{Span}\right| \le l_{drift}$$

Where:

C_{mf}	= calibration error response concentration for Cal01 (final)	=		ppmwv
C_{mi}	= calibration error response concentration for Cal00 (initial)	=		ppmwv
Span	= instrument span value	=		ppmwv
I_{drift}	= limit for system drift error	=	3.0%	
E_{drift}	= calibration drift error check value	=		

5. Average Concentration for an entire Run

$$C = \frac{\sum_{i=1}^{N} C_i}{N}$$

Where: i=1

C_i	= All concentration readings for the entirety of Run 1 for the monitor looking for THC on channel 2	=		ppmwv
N	= total number of readings in Run 1	=		
C	= average THC concentration for Run 1	=		ppmwv

6. Drift-Corrected Average Concentration for an entire Run

$$C_{DC} = \left(C - \frac{C_{oi} + C_{of}}{2}\right)\left(\frac{C_{ma}}{\frac{C_{mi} + C_{mf}}{2} - \frac{C_{oi} + C_{of}}{2}}\right)$$

C_{ma}	= concentration of actual calibration gas value	=		ppmwv
C	= average THC concentration for Run 1	=		ppmwv
C_{mf}	= calibration error response concentration for Cal01 (final)	=		ppmwv
C_{mi}	= calibration error response concentration for Cal00 (initial)	=		ppmwv
C_{of}	= calibration error response concentration for Cal01 (final) for zero gas	=		ppmwv
C_{oi}	= calibration error response concentration for Cal00 (initial) for zero gas	=		ppmwv
C_{DC}	= drift corrected average concentration for Run 1	=		ppmwv

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USEPA Method 25A
Sample Emission Calculations for THC

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

122211 142908

1. THC concentration (ppmdv)

$$C(ppmdv) = k_1 \times C_{DC} \quad if \quad dry \quad gas$$

$$C(ppmdv) = \frac{k_1 \times C_{DC}}{\left(1 - B_W/100\right)} \quad if \quad wet \quad gas$$

Where:

C_{DC}	= drift corrected average concentration	=		ppmwv
B_w	= actual water vapor in gas (% v/v)	=		% v/v
100	= conversion factor to change percentage to decimal	=	100	
k_1	= ppm/% to ppm conversion factor for diluent gases	=	% to ppm Factor	
C (ppmdv)	= THC concentration (ppmdv)	=		ppmdv

2. THC concentration (lb/dscf)

$$C(lb/dscf) = \frac{C(ppmdv) \times MW(gas)}{10^6\ ppm \times 385.3}$$

Where:

C (ppmdv)	= THC concentration (ppmdv)	=		ppmdv
MW	= Molecular Weight of THC gas	=	44.0965	lb/lb-mole
10^6	= conversion factor from decimal to ppm	=	1.00E+06	
385.3	= molar volume	=	385.3	dscf/lb-mole
C (lb/dscf)	= THC concentration (lb/dscf)	=		lb/dscf

3. THC emission rate (lb/hr)

$$E_{lb/hr} = C(lb/dscf) \times Q_{std} \times 60$$

Where:

C (lb/dscf)	= THC concentration (lb/dscf)	=		lb/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= THC emission rate (lb/hr)	=		lb/hr

4. THC Fd-based emission rate (lb/MMBtu)

$$E_{Fd} = C(lb/dscf) \times F_d \times \left(\frac{20.9}{20.9 - O_2}\right)$$

Where:

C (lb/dscf)	= THC concentration (lb/dscf)	=		lb/dscf
F_d	= ratio of gas volume to heat content of fuel (dscf/MMBtu)	=		dscf/MMBtu
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
E_{Fd}	= THC Fd-based emission rate (lb/MMBtu)	=		lb/MMBtu

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USEPA Method 18
Sample Emission Calculations for Methane

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

122211 142908

1. Methane concentration (lb/dscf)

$$C(lb/dscf) = \frac{C(ppmdv) \times MW(gas)}{10^6\ ppm \times 385.3}$$

Where:

C (ppmdv)	= THC concentration (ppmdv)	=		ppmdv
MW	= Molecular Weight of Methane gas	=	16.04276	lb/lb-mole
10^6	= conversion factor from decimal to ppm	=	1.00E+06	
385.3	= molar volume	=	385.3	dscf/lb-mole
C (lb/dscf)	= THC concentration (lb/dscf)	=		lb/dscf

2. Methane emission rate (lb/hr)

$$E_{lb/hr} = C(lb/dscf) \times Q_{std} \times 60$$

Where:

C (lb/dscf)	= THC concentration (lb/dscf)	=		lb/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= THC emission rate (lb/hr)	=		lb/hr

3. Methane Fd-based emission rate (lb/MMBtu)

$$E_{Fd} = C(lb/dscf) \times F_d \times \left(\frac{20.9}{20.9 - O_2}\right)$$

Where:

C (lb/dscf)	= THC concentration (lb/dscf)	=		lb/dscf
F_d	= ratio of gas volume to heat content of fuel (dscf/MMBtu)	=		dscf/MMBtu
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
E_{Fd}	= THC Fd-based emission rate (lb/MMBtu)	=		lb/MMBtu

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USEPA Method 18

Sample Emission Calculations for Ethane

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

122211 142908

1. Ethane concentration (lb/dscf)

$$C(lb/dscf) = \frac{C(ppmdv) \times MW(gas)}{10^6\ ppm \times 385.3}$$

Where:

C (ppmdv)	= THC concentration (ppmdv)	=		ppmdv
MW	= Molecular Weight of Ethane gas	=	30.06964	lb/lb-mole
10^6	= conversion factor from decimal to ppm	=	1.00E+06	
385.3	= molar volume	=	385.3	dscf/lb-mole
C (lb/dscf)	= THC concentration (lb/dscf)	=		lb/dscf

2. Ethane emission rate (lb/hr)

$$E_{lb/hr} = C(lb/dscf) \times Q_{std} \times 60$$

Where:

C (lb/dscf)	= THC concentration (lb/dscf)	=		lb/dscf
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=		dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= THC emission rate (lb/hr)	=		lb/hr

3. Ethane Fd-based emission rate (lb/MMBtu)

$$E_{Fd} = C(lb/dscf) \times F_d \times \left(\frac{20.9}{20.9 - O_2}\right)$$

Where:

C (lb/dscf)	= THC concentration (lb/dscf)	=		lb/dscf
F_d	= ratio of gas volume to heat content of fuel (dscf/MMBtu)	=		dscf/MMBtu
O_2	= proportion of oxygen in the gas stream by volume (%)	=		%
20.9	= oxygen content of ambient air (%)	=	20.9	%
E_{Fd}	= THC Fd-based emission rate (lb/MMBtu)	=		lb/MMBtu

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USEPA Method 3A, 6C, 7E, and 10
Sample Field Calculations for O2 and CO2

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

021414 142044

1. Average of a calibration series

$$C_{mce} = \frac{(C_1 + C_2 + C_3)}{3}$$

Where:

C_1, C_2, C_3 = concentrations of 3 consecutive gas samples that are representative of the calibration gas

C_{mce} = average concentration of a calibration series = ppmwv
In this case the low cal series for channel 2

2. Calibration Error Check for non-Hydrocarbons (2% of Instrument Span)

$$E = abs\left|\frac{C_{mce} - C_{ma}}{Span}\right| \le l_{cal}$$

Where:

C_{mce} = average concentration of a calibration series = ppmwv
In this case the low cal series for channel 2

C_{ma} = concentration of actual calibration gas value = ppmwv

Span = instrument span value =

l_{cal} = limit for calibration error for non-hydrocarbons = 2.0%

E = calibration error check value =

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3. System Bias as Percent of Span Value (5% is allowed)

$$E_{Bias} = abs\left|\frac{C_{mf} - C_{mce}}{Span}\right| \leq l_{bias}$$

Where:

C_{mce}	= average concentration of a calibration series #N/A	=		ppmwv
C_{mf}	= calibration error response concentration for Cal01	=		ppmwv
Span	= instrument span value	=		ppmwv
l_{bias}	= limit for system bias error	=	5.0%	
E_{bias}	= calibration bias error check value	=		

4. System Drift as Percent of Span Value (3%)

$$E_{Drift} = abs\left|\frac{C_{mf} - C_{mi}}{Span}\right| \leq l_{drift}$$

Where:

C_{mf}	= calibration error response concentration for Cal01 (final)	=		ppmwv
C_{mi}	= calibration error response concentration for Cal00 (initial)	=		ppmwv
Span	= instrument span value	=		ppmwv
l_{drift}	= limit for system drift error	=	3.0%	
E_{drift}	= calibration drift error check value	=		

5. Average Concentration for an entire Run

$$C = \frac{\sum_{i=1}^{N} C_i}{N}$$

Where:

C_i	= All concentration readings for the entirety of Run 1 for the monitor looking for THC on channel 2	=		ppmwv
N	= total number of readings in Run 1	=		
C	= average THC concentration for Run 1	=		ppmwv

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6. Drift-Corrected Average Concentration for an entire Run

$$C_{DC} = \left(C - \frac{C_{oi} + C_{of}}{2} \right) \left(\frac{C_{ma}}{\frac{C_{mi} + C_{mf}}{2} - \frac{C_{oi} + C_{of}}{2}} \right)$$

C_{ma}	= concentration of actual calibration gas value	=	ppmwv
C	= average THC concentration for Run 1	=	ppmwv
C_{mf}	= calibration error response concentration for Cal01 (final)	=	ppmwv
C_{mi}	= calibration error response concentration for Cal00 (initial)	=	ppmwv
C_{of}	= calibration error response concentration for Cal01 (final) for zero gas	=	ppmwv
C_{oi}	= calibration error response concentration for Cal00 (initial) for zero gas	=	ppmwv
C_{DC}	= drift corrected average concentration for Run 1	=	ppmwv

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RESUMES

C

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified accurate.

QA/QC Initials: _____

Date: _____

CleanAir

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Andrew Obuchowski
Project Manager

Professional Profile
Mr. Obuchowski has over five years experience in environmental testing. Since 2008, Mr. Obuchowski has been involved with projects utilizing Environmental Protection Agency (EPA) Methods 1 through 29, 30B, 201, 201A and 202. His current responsibilities for Clean Air Engineering involve supervising contracted projects to identify and quantify industrial air pollutant emissions. At various times, Mr. Obuchowski's responsibilities have included field test leading, continuous emission monitoring (CEM) testing, and set-up of on-site laboratory with analysis using such analyzers as the Dionex ICS-90 (ion chromatography) and Ohio Lumex (spectrometer).

Relevant Experience
Marathon Petroleum Corporation; Detroit, MI
Extensive involvement with compliance testing in regards to the Detroit Heavy Oil Upgrade Project (DHOUP) at the Detroit Refinery. Test parameters included total particulate matter as the sum of filterable particulate matter and condensable particulate matter, sulfuric acid, volatile organic compounds, SO_2, NO_X, CO, flue gas composition, and flue gas flow rate.

Cormetech, Inc.; Apollo Beach, FL
Performed MASS testing at the grid of the SCR of Units 2, 3 and 4 to determine NO_X levels. This allowed Cormetech to perform tuning of the AIG to run at optimum levels. Also tested multiple inlets/outlets to determine SO_3 conversion and ammonia slip of each unit using Methods 8B and CTM-027.

AmerenEnergy; Bartonville, IL
Conducted diagnostic testing at the outlets of Units 2 and 3 stacks. Data was to be used in the design of a new scrubber system. Constituents sampled included HCl, HF, TSP, CPM and particle sizing. Testing included EPA Methods 5, 26, CTM-028 and In-Situ Anderson Impactor.

Dynegy Midwest Generation; Havana, IL
Carried out mercury testing at the stack utilizing Method 30B. First part of the test program included performing a relative accuracy test audit of the plant's on-site mercury system to verify validity. The second part determined removal efficiency through comparing mercury analysis of coal versus stack emission. Removal efficiency results allowed for the plant to optimize the activated carbon injection at the baghouse.

Wheelabrator Environmental Services, Inc; Pompano Beach, FL
Performed compliance testing for the North and South Broward Resource Recovery facility. Testing was performed at the FF Outlets and SDA Inlets of all three units at both facilities, utilizing EPA Methods 1, 2, 3, 3A, 3B, 4, 5, 6C, 7E, 9, 10, 13B, 22, 23, 26A, 29, PS-2, PS-3, PS-4A and PS-6.

Marsulex Environmental Technologies; LaGrange, TX
Performed FGD performance testing at the LCRA Fayette Generating Station. Locations included the FGD Inlet and Stack. Methods used included 1, 2, 3, 3A, 4, 5, 6, 19, 26A, 202 and ASTM-D6784-02.

Professional Certifications
Qualified Stack Testing Individual (QSTI) Groups I, II, III and IV, Application No. 2011-587
Visible Opacity Reading

Education
Bachelor of Science, Environmental Science, 2008
University of Illinois; Urbana-Champaign, Illinois

Kevin E. Farwell
Southern Engineering Group Leader

Professional Profile

Mr. Farwell has 21 years experience in managing and leading teams in the environmental field including compliance testing, solid and hazardous waste and remediation. He has been responsible for planning and managing sampling programs, daily assignments of field testing crews, sample analysis, data reduction, QA/QC reviews, and reporting activities, supervised and/or participated in thousands of source tests across the United States and into Alaska.

Sampling experience includes almost the entire gamut of EPA wet and instrumental test methods as well as those from the National Council for Air and Stream Improvement (NCASI), National Institute of Occupational Safety and Health (NIOSH), American Society of Testing and Materials (ASTM), California Air Resource Board (CARB), Bay Area Air Quality Management District (BAAQMD), South Coast Air Quality Management District (SCAQMD), Oregon Department of Environmental Quality (ODEQ), Washington State Department of Ecology (WDOE) and various regional agencies.

Relevant Experience

Nevada Cement Corporation, Fernley Nevada

Project managed and coordinated a 12 person team over 24 exhaust locations throughout the property. The purpose of testing was to demonstrate compliance with the State of Nevada, Bureau of Air Pollution Controls Class I Air Quality Operating Permit. The test methodology consisted of analysis for, multi-metals, filterable particulates, condensable particulates, Non-Methane Organic Compounds (NMOC), continuous emission monitoring (CEMS), visible emissions and Hydrogen Chloride via method 320 (FTIR).

Archer Daniels Midland, Columbus Nebraska

Coordinated and supervised a team of 6 in completion of a project at a corn processing facility in Columbus Nebraska. The purpose of the campaign was to assist the client in meeting the start up requirements of their Air Quality Construction Permits totaling 14 new sources. Analyses were conducted for filterable particulate, condensable particulate, CEMS and HAPs via Method 320.

Pioneer Trail Energy, Wood River Nebraska

Project managed and assisted in initial testing on the clients CO_2 Scrubbing unit with additional testing events utilizing alternative media types. The data obtained from this projected helped the client make informed decisions on the proper media selection and also supplied the manufacturer information to help satisfy their emission guarantee of the scrubber.

Ocean Protein, Aberdeen Washington
Project managed and coordinated a year-long study for a client of a fish meal processing plant attempting to control unpleasant odors escaping their facility. The odor emitting the facility was resulting in numerous public complaints causing unwanted scrutiny from the local air agencies and press. A portion of the study consisted of controlled amounts of methyl mercaptan and butyl mercaptan being injected on the upstream side of their scrubbers with samples being collected on the outlet for analysis. Scrubbing solutions, scrubber flow rates and an innovative Air-Phaser technology were deployed as result of the findings. Ocean Protein committed more than $5 million in advancing their odor control technologies partly based on the results of this study.

Professional Certifications
QSTI Groups 1, 2, 3 and 4 (2008-250)
Course 450 – Source Sampling for Particulate Pollutants

Education
Eastern Arizona College (1 year)
Morenci High School

PERTINENT CERTIFICATIONS

K

I hereby certify that all pages contained within this Appendix have been reviewed and, to the best of my ability, verified as accurate.

QA/QC Initials: RWK

Date: 05/14

CleanAir

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SOURCE EVALUATION SOCIETY

Qualified Source Testing Individual

LET IT BE KNOWN THAT

ANDREW H. CHRISTIANSEN

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

MANUAL GAS VOLUME MEASUREMENTS AND ISOKINETIC PARTICULATE SAMPLING METHODS

ISSUED THIS 25TH DAY OF AUGUST 2010 AND EFFECTIVE UNTIL AUGUST 24TH, 2015

Peter R. Westlin, QSTI/QSTO Review Board

C. David Bagwell, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

Karen D. Kajiya-Mills , QSTI/QSTO Review Board

LeRoy Owens, QSTI/QSTO Review Board

Glenn C. England, QSTI/QSTO Review Board

APPLICATION NO. 2009-295

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Qualified Source Testing Individual

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MANUAL GASEOUS POLLUTANTS SOURCE SAMPLING METHODS

ISSUED THIS 25TH DAY OF AUGUST 2010 AND EFFECTIVE UNTIL AUGUST 24TH, 2015

Peter R. Westlin, QSTI/QSTO Review Board

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GASEOUS POLLUTANTS INSTRUMENTAL SAMPLING METHODS

ISSUED THIS 25TH DAY OF AUGUST 2010 AND EFFECTIVE UNTIL AUGUST 24TH, 2015

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